

1958-1959

suppliers' catalogs

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Ceramic Data Book

SEWER PIPE • ELECTRONIC CERAMICS • CLAY AGGREGATE • ALLIED PRODUCTS

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CERAMIC DATA BOOK

With

SUPPLIERS CATALOGS

and

BUYERS' DIRECTORY

of

Equipment and Materials



Including

A comprehensive set of charts and tables of technical data for the glass, porcelain enamel, pottery, refractories, structural clay products, electronic ceramics, and allied industries.



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BUYERS' DIRECTORY

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You will find this Buyers' Directory has been thoroughly revised for this edition. This will enable you to find easier and quicker, the several firms under each item, whose sales policies indicate that they are most interested and anxious to serve your needs for equipment, materials and services.

You can obtain more details from the firms listed in **bold** face type by referring to their catalogs in the book, or by writing them.

We have aimed as far as possible to list only the producers of a certain item, but you will readily recognize that it is difficult at times to differentiate between a producer and a jobber. Some items are bought and incorporated into a piece of equipment or a batch material. In those cases we have decided on only one basis—what is for the best interest to you—the buyer.

In case you look for buying information on an item not included here—ask our editors.

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 Roura Iron Works, 1403 Woodland Ave., Detroit 11, Mich.

BOXES, Ware

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 Marsh Lumber Co., Dover, Ohio

CABLE, Electric Insulated

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CARBIDES, Tungsten

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Ton-Tex Corp., 247 Pearl St., N. W., Grand Rapids 2, Mich.

CASTERS, Truck

American Brake Shoe Co., 230 Park Ave., New York 17, N. Y.
 Chase Foundry & Mfg. Co., 2300 Parsons, Columbus 7, Ohio
 Ton-Tex Corp., 247 Pearl St., N. W., Grand Rapids 2, Mich.

CASTING RACKS

Alpine, A. D., 11837 Teale Ave., Culver City, Calif.

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 Island Equipment Corp., 27-01 Bridge Plaza North, Long Island City 1, N. Y.
 Jeffrey Mfg. Co., The, 913 N. Fourth St., Columbus 16, Ohio

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 Brinkman Instruments, Inc., 115 Cutter Mill Rd., Great Neck, N. Y.
 General Electric Co., 1 River Rd., Schenectady 5, N. Y.

COLORS, Ceramic

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Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Mason Color & Chemical Works, Inc., 206-214 Broadway, E. Liverpool, Ohio (p. 205)
Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)
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CONVEYORS, Alloy

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 International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
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 Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
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 Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
 Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
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CONVEYORS, Cable

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CONVEYORS, Cable Drag

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 Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

CONVEYORS, Continuous Power

Mathews Conveyor Co., Tenth St., Ellwood City, Pa. (p. 208)
 Richard-Wilcox Mfg. Co., 2176 Third St., Aurora, Ill. (p. 257)
 Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)
 Wahl, A. J., Inc., 8 Central Ave., Brocton, N. Y. (p. 317)

CONVEYORS, Drag Chain

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 Fiedler, C. O., Inc., P. O. Box 15433, Vernon Branch, Los Angeles 58, Calif. (p. 150)
 Hendryx, Dwight B. & Assoc., 6621 Darlington Rd., Pittsburgh 17, Pa. (p. 177)
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CONVEYORS, Electric Vibrating

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 Mathews Conveyor Co., Tenth St., Ellwood City, Pa. (p. 208)
 Snytron Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
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 Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

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 Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
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CONVEYORS, Mechanical Vibrating

Denison Engineering Div., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
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CONVEYORS, Monorail

(See Conveyors, Trolley)

CONVEYORS, Oscillating

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 Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.
 Proctor & Schwartz, Inc., 7th Street & Tabor Rd., Philadelphia 20, Pa.

CONVEYORS, Overhead

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 Wahl, A. J., Inc., 8 Central Ave., Brocton, N. Y. (p. 317)
 Wickwire Spencer Steel Div., The Colorado Fuel and Iron Corp., 575 Madison Ave., New York 22, N. Y. (p. 322, 323)
 Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia 20, Pa.

CONVEYORS, Pneumatic

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CONVEYORS, Portable

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CONVEYORS, Roller

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CONVEYORS, Roller & Live Roller

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 Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)
 Mathews Conveyor Co., Ellwood City, Pa. (p. 208)
 Wahl, A. J., Inc., 8 Central Ave., Brocton, N. Y. (p. 317)
 Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

CONVEYORS, Rotary Tubular

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 Hardinge Co., Inc., York, Pa. (p. 164)
 Wahl, Inc., A. J., 8 Central Ave., Brocton, N. J. (p. 317)
 Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

CONVEYORS, Scraper

Continental Gin Co., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)
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CONVEYORS, Screw

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 International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
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 Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
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CONVEYORS, Slot

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CONVEYORS, Steel Belting

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Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
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CONVEYORS, Trolley

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Richards-Wilcox Mfg. Co., 2176 Third St., Aurora, Ill. (p. 257)
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CONVEYORS, WIRE Rope

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Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia 20, Pa.
Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

COOLERS, Kiln

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Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
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COPPER

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Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
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CORNWALL STONE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Consolidated Feldspar Dept. of International Minerals & Chem. Corp., 20 N. Wacker Drive, Chicago 6, Ill. (p. 118)
Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
English China Clays Sales Corp., 6 E. 45th St., New York 17, N. Y. (p. 145)
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Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
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COUPLINGS, Flexible

Continental Gin Co., Industrial Div., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)
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Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

COUPLINGS, Hydraulic

American Blower Div. of American Standard, 8111 Tireman Rd., Detroit 4, Mich.
Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

CRANES, Material Handling

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Richards-Wilcox Mfg. Co., 2176 Third St., Aurora, Ill. (p. 257)
Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

CRANES, Tractor

Link-Belt Corp., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

CRANES, Traveling

Richards-Wilcox Mfg. Co., 2176 Third St., Aurora, Ill. (p. 257)
Link-Belt Speeder Corp., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

CRANKS

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Potters Supply Co., 11 Washington, East Liverpool, Ohio (p. 249)
Shenango Refractories, Div. of Shenango China, Inc., P. O. Box 120, New Castle, Pa. (p. 268)

CRATES, Wirebound

Wirebound Box Mfrs. Assn., 327 S. LaSalle St., Chicago 4, Ill.

CREAM OF TARTAR

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)

Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
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Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
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Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

CRUCIBLE, Fire Clay

New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
Potters Supply Co., 11 Washington, East Liverpool, Ohio (p. 249)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
Ceramic Supply Co., P. O. Box 151, Crooksville, Ohio

CRUCIBLES, Platinum

McDaniel Refractory Porcelain Co., 500 Ninth Ave., Beaver Falls, Pa. (p. 206, 207)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)

CRUSHER ROLLS AND SHELLS

American Clay Machinery Div., Huber-Warco Co., P. O. Box 501, 202 N. Greenwood St., Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd. S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Exolon Co., 941 E. Niagara St., Tonawanda, N. Y. (p. 142, 143)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Miller Equip. Co., Salisbury, N. C. (p. 214)
Posey Iron Works, Inc., Brick Mch. & Mixer Div., Lancaster, Pa. (p. 248)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Stevenson Co., The, Wellsville, Ohio (p. 289-294)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
Toronto Foundry & Machine Co., Toronto, Ohio (p. 306)

CRUSHERS, Grog

American Clay Machinery Div., Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)
Posey Iron Works, Inc., Brick Mch. & Mixer Div., Lancaster, Pa. (p. 248)
Steele & Co., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
Williams Patent Crusher & Pulverizer Co., 2709 N. Broadway, St. Louis 6, Mo. (p. 321)

CRUSHERS, Gyratory

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)

CRUSHERS, Hammer

American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Bonnot Co., The, 721 Mulberry Rd. S.E., Canton 2, Ohio (p. 94)

CLASSIFIED DIRECTORY OF SUPPLIERS

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Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)
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Pulverizing Mch. Div., Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

CRUSHERS, Jaw

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
American Clay Machinery Div., Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Pulverizing Mch. Div., Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
Toronto Foundry & Machine Co., Toronto, Ohio (p. 306)
Pennsylvania Crusher Div. of Bath Iron Works, Inc., Rm. 1723, West Chester, Pa.

CRUSHERS, Laboratory

Abbe, Paul O., 377 Center Ave., Little Falls, New Jersey (p. 62, 63)
Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
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Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles, Calif. (p. 148)
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International Clay Machinery Co., 1145 Bolander Ave., P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
International Engr., Inc., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)
Patterson Fdy. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Pulverizing Mach. Div., 65 Chatham Rd., Summit, N. J. (p. 250)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

CRUSHERS, Ring

Abbe Engineering Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

CRUSHERS, Roll

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
American Clay Machinery Div., Huber-Warco Co., P. O. Box 501, 202 N. Greenwood St., Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd. S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Exolon Co., 941 East Niagara St., Tonawanda, N. Y. (p. 142, 143)
Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Hendryx, Dwight B. & Assoc., 6621 Darlington Rd., Pittsburgh 17, Pa. (p. 177)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
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Posey Iron Works, Inc., Brick Mch. & Mixer Div., Lancaster, Pa. (p. 248)
Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Stevenson Co., The, Wellsville, Ohio (p. 289-294)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 308)
Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

CRYOLITE, Synthetic

Aluminum Limited Sales, Inc., 630 Fifth Ave., New York 20, N. Y. (p. 61)
Aluminum Co. of America, 1501 Alcoa Bldg., Pittsburgh, Pa. (p. 74, 75)
Ceramic Color & Chem. Mfg., P. O. Box 81, New Brighton, Pa. (p. 100)
Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
McGean Chemical Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)

CULLET

Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)
Sturtevant Mill Co., 6 Harrison Sq., Boston 22, Mass. (p. 288)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

CULLET HANDLING EQUIPMENT

Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
Schmid Co., Arthur W., Investment Building, Pittsburgh 22, Pa. (p. 266)
Sturtevant Mill Co., 6 Harrison Sq., Boston 22, Mass. (p. 288)

CULLET WASHING PLANTS

Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)
Universal Atlas Cement Co., 100 Park Ave., New York 17, N. Y. (p. 313, 316)

CUP TURNING MACHINES

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Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
Wahl Inc., A. J., 2-8 Central Ave., Brocton, N. Y. (p. 317)

CUTTERS, Brick and Tile

American Clay Machinery Div., Huber-Warco Co., P. O. Box 501, 202 N. Greenwood St., Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)
Fernholtz Machinery Co., 8468D Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Steele & Sons, Inc., J. C., P. O. Box 951, Statesville, N. C. (p. 284-287)
Universal Atlas Cement Co., 100 Park Ave., New York 17, N. Y. (p. 313-316)

CUTTING AND DRESSING MACHINES

Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Universal Atlas Cement Co., 100 Park Ave., New York 17, N. Y. (p. 313-316)

CYANIDES

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Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
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CYANITE

(See Kyanite)

CYLINDERS, Air Power

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)

Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Miller Fluid Power Div. Flick-Reedy Corp., 2002-8 N. Hawthorne Ave., Melrose Park, Ill. (p. 215)
Minneapolis-Honeywell Regulator Co., Wayne and Windram Aves., Philadelphia 44, Pa. (p. 212, 213)
Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.
Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio (p. 293)

CYLINDERS, Hydraulic Power

Bonnot Co., 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
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Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
Miller Fluid Power Div. Flick-Reedy Corp., 2002-8 N. Hawthorne Ave., Melrose Park, Ill. (p. 215)
Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.
Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

DE-AIRING EQUIPMENT

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Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Chisholm, Boyd & White Co., 610 W. 57th St., Chicago 21, Ill. (p. 125-136)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melros Place, Los Angeles 46, Calif. (p. 148)
Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdry. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Toronto Foundry & Machine Co., Trenton St., Toronto, Ohio (p. 306)

DECALCOMANIA

Drakenfeld & Co., B. F., 45-47 Park Place, New York 7, N. Y. (p. 137)
Hommel Co., The, O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)
Croxxall Chemical & Supply, Box 757, E. Liverpool, Ohio

DECALCOMANIA PAPER

Drakenfeld & Co., B. F., 45-47 Park Place, New York 7, N. Y. (p. 137)
Hommel Co., The, O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)

DECALCOMANIA SIZE

Ceramic Color & Chemical Mfg. Co., New Brighton, Pa. (p. 100)
Drakenfeld & Co., B. F., 45-47 Park Place, New York 7, N. Y. (p. 137)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., The, O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Croxxall Chemical & Supply, P. O. Box 757, E. Liverpool, Ohio

DECOLORIZERS

Ceramic Color & Chemical Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Drakenfeld & Co., B. F., 45-47 Park Place, New York 7, N. Y. (p. 137)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

DECORATING MACHINE, Automatic

Hommel Co., The O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)
Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

DECORATING MACHINE, Pottery

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)
Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

DECORATING PROCESS, for Glass, Pottery and Enamel

Ceramic Color & Chemical Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
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Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)
Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)
Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

DECORATING SUPPLIES

Ceramic Color & Chemical Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
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Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Mason Color & Chemical Works, Inc., 210 Broadway, E. Liverpool, Ohio (p. 205)
Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 9, Pa. (p. 89)

DE-ENAMELING COMPOUNDS

Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

DEFLOCCULANT, Organic

(See Electrolytes)

DEFLOCCULANTS

(See Electrolytes)

DEGREASING MACHINE

Detrex Corp., Box 501, Detroit 32, Mich.
Ranschoff, Inc., N., 16 E. 72nd St., Cincinnati 16, Ohio

DEGREASING SOLVENTS

Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
Stauffer Chemical Co., 380 Madison Ave., New York 17, N. Y. (p. 272)

DE-IONIZED WATER CONTROL

(See Demineralizers)

DELIVERY TRUCKS, Brick

Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)

DEMINERALIZERS

Illinois Water Treatment Co., 840 Cedar St., Rockford, Ill.
Industrial Filter & Pump Mfg. Co., 5900 W. Ogden Ave., Chicago, Ill.

DEXTRIN

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Croxtall Chemical & Supply, Box 757, East Liverpool, Ohio

DIATOMACEOUS EARTH

Ceramic Color & Chemical Mfg. Co., New Brighton, Pa. (p. 100)
Eagle-Picher Co., Am. Bldg., Cincinnati 1, Ohio (p. 141)
Harbison-Walker Refractories Co., 307 Fifth Ave., Pittsburgh 22, Pa. (p. 162, 163)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., The O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Johns-Manville, 22 E. 40th St., New York 16, N. Y. (p. 184, 185)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
McGean Chemical Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

DIE LUBRICANT

American Clay Machy. Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Specialty Products Co., 190 Warren St., Jersey City 2, N. J.

DIES AND DIE ACCESSORIES

American Clay Machinery Div. of Huber-Warco Co., P. O. Box 501, 202 N. Greenwood St., Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd., S. E. Canton 2, Ohio (p. 94)
Cammerzell Tool & Die Works, Ohio Ave. & Strawberry St., Trenton 8, N. J. (p. 99)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Loomis Engineering & Manufacturing Co., Dept. CD, Route 46 & Clinton Rd., Caldwell, N. J. (p. 198)
Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
National Lead Co., Titanium Alloy Mfg. Co., 111 Broadway, New York 6, N. Y. (p. 299-302)
Steele & Sons, Inc., J. C., P. O. Box 951, Statesville, N. C. (p. 284-287)
Stevenson Co., The, Wellsville, Ohio (p. 289-294)
Toronto Foundry & Machine Co., Trenton St., Toronto Ohio (p. 306)
U. S. Stoneware Co., 12 East Ave., Tallmadge, Ohio (p. 311)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

DIGGING MACHINERY, Clay

(See also Shovels Power; Draglines and Shale Planers)

Syntron Co., 750 Lexington, Homer City, Pa. (p. 296)

DISINTEGRATORS

Abbe Engineering Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)

Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L. V. R. R., Metuchen, N. J. (p. 192)
National Engineering Co., 602 Machinery Hall Bldg., Chicago 6, Ill. (p. 273, 274)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Posey Iron Works, Inc., Brick Mchy. & Mixer Div., Lancaster, Pa. (p. 248)
Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 289-294)

DISODIUM PHOSPHATE

(See Phosphates)

DITCHING MACHINES

Barber-Greene Co., 400 N. Highland Ave., Aurora, Ill.
Bucyrus-Erie Co., South Milwaukee, Wis.
Koehring Co., 3026 W. Concordia Ave., Milwaukee 16, Wis.

DOLLIES

Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
Chase Foundry & Mfg. Co., 2300 S. Parsons Ave., Columbus 7, Ohio
Port-A-Lift Co., The, 2998 N. Euclid Ave., Bay City, Mich.

DOLOMITE

Ceramic Color & Chemical Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
Tennant, C., Sons & Co., of N. Y., 100 Park Ave., N. Y. 17, (p. 234, 235)
United States Gypsum Co., 300 W. Adams St., Chicago 6, Ill. (p. 308, 309)

DOOR OPERATORS, Electric

Richards-Wilcox Mfg. Co., Aurora, Ill. (p. 257)

DOORS, Fire

Richards-Wilcox Mfg. Co., Aurora, Ill. (p. 257)
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 575 Madison Ave., New York 22, N. Y. (p. 322, 323)

DOORS, Industrial

Richards-Wilcox Mfg. Co., Aurora, Ill. (p. 257)

DRAGLINES

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 361 Delaware Ave., Buffalo 2, N. Y. (p. 322, 323)
Link-Belt Corp., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

DRAWING COMPOUNDS

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Specialty Products Co., 190 Warren St., Jersey City 2, N. J.

DRAWING MACHINES, Glass

Schmid Co., Arthur W., Investment Building, Pittsburgh 22, Pa. (p. 266)

DRILLS, Core

Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)

DRILLS, Electric

Syntron Co., 750 Lexington, Homer City, Pa. (p. 296)

CLASSIFIED DIRECTORY OF SUPPLIERS

DRILLS, Glass

Action Diamond Tool Co., 125 W. Hubbard St., Chicago 10, Ill.

DRILLS, Mine

Worthington Corp., So. 2nd St., Plainfield, N. J. (p. 324)

General Electric Co., 11177 East Eight Mile Rd., Detroit 32, Mich.

DRIVES, Chain

Continental Gin Co., Industrial Div., 4500 5th Ave. So., Birmingham, Ala. (p. 119)

Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

DRIVES, Fluid

American Blower Div. of American Standard, Detroit 32, Mich.

Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

DRIVES, Gear

(See also Reducers, Speed)

Continental Gin Co., Industrial Div., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)

Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)

Stevenson Co., The, First St., Wellsville, Ohio (p. 289-294)

Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

DRIVES, Variable Speed

Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)

Continental Gin Co., Industrial Div., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)

Stevenson Co., The, First St., Wellsville, Ohio (p. 289-294)

Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)

Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)

DRIVES, V-Belts

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DRUM HOISTS

American Clay Machinery Div., Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)

Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)

Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)

Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)

Harrop Ceramic Service, 35 E. Gay St., Columbus 15, Ohio (p. 169-172)

Hommel, O. Co., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)

Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)

Posey Iron Works, Inc., Harrisburg Pike, Lancaster, Pa. (p. 248)

Steele & Sons, Inc., J. C. P. O. Mulberry St., Statesville, N. C. (p. 284-287)

DRYER CARS

(See Cars, Dryer)

DRYERS, Air

International Clay Machinery Co., 1145 Bolander Ave., P. O. Box 973, Dayton 1, Ohio (p. 182, 183)

Lawly Co., 2800 Euclid Ave., Cleveland 15, Ohio (p. 201-204)

Lawler Co., Durham Ave. & L. V. R. R., Metuchen, N. J. (p. 192)

Pereny Equipment Co., 893 Chambers Rd., Box 153, Stn. A., Columbus 12, Ohio (p. 244, 245)

Stokes, F. J., Corp., 5500 Tabor Rd., Philadelphia 20, Pa. (p. 283)

Surface Combustion Corp., 2375 Door St., Toledo 1, Ohio (p. 295)

Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia 20, Pa.

DRYERS, Clay and Clay Slip

Bonnot Co., 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)

Bowen Engineering, Inc., North Branch, N. J. (p. 96, 97)

Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)

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Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)

Lawly Co., 2800 Euclid Ave., Cleveland 15, Ohio (p. 201-204)

Lawler Co., Durham Ave. & L. V. R. R., Metuchen, N. J. (p. 192)

Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)

Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. (p. 223)

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DRYERS, Enamel

Binks Manufacturing Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)

Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)

Harrop Ceramic Service, 35 E. Gay St., Columbus 15, Ohio (p. 169-172)

Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)

Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)

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Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)

Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia 20, Pa.

DRYERS, Flash

Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)

Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. (p. 223)

DRYERS, Heavy Clay

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Bonnot Co., The, 721 Mulberry Rd., S. E. Canton 2, Ohio (p. 94)

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Hendryx & Assoc., Dwight B., 6621 Darlington Rd., Pittsburgh 17, Pa. (p. 177)

International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)

Lawly Co., The, 2800 Euclid Ave., Cleveland 15, Ohio (p. 201-204)

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Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. (p. 223)

Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)

Posey Iron Works, Inc., Harrisburg Pike, Lancaster, Pa. (p. 248)

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Swindell-Dressler Corp., P. O. Box 1888, Pittsburgh 30, Pa. (p. 275-282)

DRYERS, Infrared

(Also see Infrared Equipment)

Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)

Lawly Co., 2800 Euclid Ave., Cleveland 15, Ohio (p. 201-204)

Miller Pottery Engineering Co., 2300 Palmer St., Swiseseale, Pittsburgh 18, Pa. (p. 216)

Syntroon Co., 750 Lexington Ave., Homer City, Pa. (p. 296)

Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia 20, Pa.

Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

DRYERS, Instantaneous

Bowen Eng., Inc., North Branch, N. J. (p. 96, 97)

Nichols Engineering & Research Corp., 70 Pine St., New York 5, New York (p. 223)

Instant Drying Corp., 101 Park Ave., New York 17, N. Y.

DRYERS, Jet

Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)

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Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. (p. 223)

Posey Iron Works, Inc., Brick Mach. and Mixer Div., Harrisburg Pike, Lancaster, Pa. (p. 248)

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Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

Proctor & Schwartz, Inc., 7th & Tabor Rd., Philadelphia 20, Pa.

DRYERS, Laboratory

Bowen Eng. Co., North Branch, N. J. (p. 96, 97)

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Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)

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Pereny Equipment Co., 893 Chambers Rd., Columbus 12, Ohio (p. 244, 245)

Wahl, A. J., Inc., 8 Central Ave., Brocton, N. Y. (p. 317)

DRYERS, Pottery & Porcelain

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Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles, Calif. (p. 148)

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Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)

Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)

International Engr., Inc., 1145 Bolander Ave., Dayton 1, Ohio (p. 180)

Lawly Co., 2800 Euclid Ave., Cleveland 4, Ohio (p. 201-204)

Lawler Co., Durham Ave. & L. V. R. R., Metuchen, N. J. (p. 192)

Miller Pottery Eng. Co., 2300 Palmer St., Swiseseale (Pittsburgh 18, Pa. (p. 216)

Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)

Pereny Equipment Co., 893 Chambers Rd., Box 153, Stn. A., Columbus 12, Ohio (p. 244, 245)

Ram, Inc., 1064 W. Fifth Ave., Columbus 8, Ohio (p. 251)

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DRYERS, Rotary

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Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)

Patterson-Kelley Co., Inc., 10 Warren St., East Stroudsburg, Pa. (p. 237-240)

Stokes Corp., F. J., 5500 Tabor Rd., Philadelphia 20, Pa. (p. 283)

Sturtevant Mill Co., 6 Harrison Sq., Dorchester, Boston, Mass. (p. 288)

DRYERS, Sand

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 Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. (p. 223)
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DRYERS, Spray

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 Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)
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 Instant Drying Corp., 101 Park Ave., New York 17, N. Y.
 Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia 20, Pa.

DRYERS, Steam

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DRYERS, Washed Clay

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DRYERS, Waste Heat

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DRY PRESS BRICK MACHINERY

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DUMPERS, Car

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 Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

DUST and FUME SAMPLING EQUIPMENT

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DUST COLLECTORS

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DUST CONTROL SYSTEMS

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DYNAMITE

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EARTH-MOVING EQUIPMENT

Lawler Co., Durham Ave., Metuchen, N. J. (p. 192)
 Link-Belt Corp., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

EDGE GLAZING MACHINE

Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

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 National Engineering Co., 602 Machinery Hall Bldg., Chicago 6, Ill. (p. 273, 274)
 Schmid Co., Arthur W., Investment Building, Pittsburgh 22, Pa. (p. 266)
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 Toronto Foundry & Machine Co., Trenton St., Toronto, Ohio (p. 306)
 Williams Patent Crusher & Pulverizer Co., 2701 N. Broadway, St. Louis 6, Mo. (p. 321)

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(See Waxes)

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 Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)
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ENAMELS, Acid Resisting

American Porcelain Enamel Co., 125 E. Keating, Muskegon, Mich. (p. 69)
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FLASHING COMPOUNDS Chemical

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Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 575 Madison Ave., New York 22, N. Y. (p. 322, 323)
 General Coal Co., Fidelity Philadelphia Trust Bldg., Philadelphia 9, Pa.
 Southern Coal Co., Inc., 333 N. Michigan Ave., Chicago 1, Ill.

FUEL, Gas

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 American Gas Association, 420 Lexington Ave., New York 17, N. Y.
 Gasair Associates, 68 Post, San Francisco, Calif.

FUEL OIL

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 Pure Oil Co., 35 E. Wacker Dr., Chicago 1, Ill.
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 General Glass Equip. Co., Atlantic Trust Bldg., Atlantic City, N. J.
 Hartford-Empire Co., Div. of Emhart Mfg. Co., 333 Homestead Ave., Hartford 12, Conn.

GLASS MACHINES, Grinding and Polishing

Frazier-Simplex, Inc., 436 E. Beau St., Washington, Pa.
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 Lynch Corp., 2304 Crystal Ave., Anderson, Ind.

GLASS MACHINES, Semi-Automatic

Frazier-Simplex, Inc., 436 E. Beau St., Washington, Pa.
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HOSE, Fire

Hewitt Rubber Div., Hewitt-Robins Inc., 240 Kensington Ave., Buffalo 14, N. Y.
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HOSE, Sand Blast

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KILNS, Radiant Tube

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KILNS, Rotary

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KILNS, Tunnel

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Milligan Hardware & Supply Co., The, 115-117 E. 5th St., East Liverpool, Ohio
Sculpture House, 304 W. 42nd St., New York 36, N. Y.

KNIVES, Pug Mill

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Westinghouse Electric Corp., Bloomfield, N. J.

LAWN CLOTH

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LEAD CHROMATE

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LEAD OXIDE

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LEAD ZIRCONIUM SILICATE

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LEHR CONVEYORS

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American Truck & Body Co., P. O. Box 1391, Martinsville, Va.
Builders Equipment Co., 3810 N. Central Ave., Phoenix, Ariz.
Side-O-Matic Unloader Corp., P. O. Box 1561, York, Pa.

LOADERS, Mine

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New York Blower Co., 2155 Shields Ave., Chicago 16, Ill.

LUBRICATING SYSTEMS, Pressure and Automatic

General Glass Equipment Co., 5 S. Virginia Ave., Atlantic City, N. J.

LUBRICANTS

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Acheson Colloids Co., Port Huron, Mich.
Specialty Products Co., 190 Warren St., Trenton, N. J.
Union Carbide & Carbon Corp., Silicones Division, 420 Lexington Ave., New York 17, N. Y.

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LUBRICANTS, Colloidal Graphite

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Acheson Colloids Co., Port Huron, Mich.
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Acheson Colloids Co., Port Huron, Mich.
Specialty Products Co., 190 Warren St., Jersey City 2, N. J.
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Pure Oil Co., 35 E. Wacker Dr., Chicago 1, Ill.
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Pure Oil Co., 35 E. Wacker Dr., Chicago 1, Ill.
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LUBRICANTS, Kiln Car

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Socony Mobil Oil Co., Inc., 150 E. 42nd St., New York 17, N. Y. (p. 269)
Acheson Colloids Co., Port Huron, Mich.
Carbide & Carbon Chem. Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Pure Oil Co., 35 E. Wacker Dr., Chicago 1, Ill.
Specialty Products Co., 190 Warren St., Jersey City 2, N. J.

LUBRICANTS, Lehr

Socony Mobil Oil Co., Inc., 150 E. 42nd St., New York 17, N. Y. (p. 269)
Acheson Colloids Co., Port Huron, Mich.
Pure Oil Co., 35 E. Wacker Dr., Chicago 1, Ill.
Specialty Products Co., 190 Warren St., Jersey City 2, N. J.

LUBRICANTS, Molybdenum Disulfide

Acheson Colloids Co., Port Huron, Mich.
Specialty Products Co., 190 Warren St., Jersey City, N. J.

LUMINOUS FLAME BURNERS

(See Burners, Luminous Flame)

LUSTER COLORS

Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Croal Chemical & Supply, P. O. Box 757, East Liverpool, Ohio

MACHINE SHOP EQUIPMENT

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Buffalo Forge Co., 128 Mortimer St., Buffalo 4, N. Y.

MACHINES, Automatic Dinnerware Forming

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fernholtz Machinery Co., 8468D Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Miller Pottery Engr. Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 182, 183)
Ram, Inc., 1064 W. 5th Ave., Columbus 8, Ohio (p. 216)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

MACHINES, Brick Facing

Rockfacer Co., 503 Hickory Tree Rd., Mesquite, Texas

MACHINES, Plastic Pressing

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Ram, Inc., 1064 W. Fifth Ave., Columbus, Ohio (p. 251)
Stokes, F. J., Corp., 5500 Tabor Rd., Philadelphia 20, Pa.
Wahl, A. J., Inc., 8 Central Ave., Brocton, N. Y. (p. 317)

MACHINES, Special

Bonnot Co., 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Continental Gin Co., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)
Fiedler, C. O., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Miller Pottery Engr. Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
Rockfacer Co., 503 Hickory Tree Rd., Mesquite, Texas (p. 261)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Stevenson Co., Wellsville, Ohio (p. 289-294)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

MACHINES, Tile Cutting

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd. S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Crossley Mach. Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)

MAGNESITE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
Harbison-Walker Refr. Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162, 163)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

MAGNESIUM, Compounds of

Aluminium Limited Sales, Inc., 630 Fifth Ave., New York 20, N. Y. (p. 61)
 Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Columbian Carbon Co., 380 Madison Ave., New York 17, N. Y. (p. 116)
 Consolidated Feldspar Dept., International Minerals & Chemical Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
 Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
 Foote Mineral Co., 436 Eighteen W. Cheltenham Bldg., Philadelphia 44, Pa. (p. 151)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
 Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
 United States Gypsum Co., 300 W. Adams St., Chicago 6, Ill. (p. 308, 309)
 Vitro Mfg. Co., 60 Greenway Drive, Pittsburgh 4, Pa. (p. 89)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

MAGNESIUM STEARATE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

MAGNESIUM ZIRCONIUM SILICATE

Ceramic Color & Chem. Mfg. Co., New Brighton, Pa. (p. 100)
 Titanium Alloy Mfg. Div., National Lead Co., 111 Broadway, New York 6, N. Y. (p. 299-302)

MAGNETIC SEPARATORS

(See Separators, Magnetic)

MAGNETITE

Samuel, Frank, & Co., Phila. National Bank Bldg., Philadelphia 7, Pa. (p. 264)
 Shieldalloy Corp., East Blvd., Newfield, N. J.

MAGNETITE, Synthetic

Columbian Carbon Co., 380 Madison Ave., New York 17, N. Y. (p. 116)
 Foote Mineral Co., Rm. 436, 18 W. Cheltenham Bldg., Philadelphia 44, Pa. (p. 151)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Shieldalloy Corp., East Blvd., Newfield, N. J.

MAGNETS, Electric

Exolon Co., 941 East Niagara St., Tonawanda, N. Y. (p. 142, 143)
 Fernholtz Machinery Co., 8468D Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Frantz Co., Inc., S. G., P. O. Box 1138, Trenton 6, N. J. (p. 152)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

MAGNETS, Permanent

Exolon Co., E. Niagara St., Tonawanda, N. Y. (p. 142, 143)
 Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Frantz Co., Inc., S. G., P. O. Box 1138, Trenton 6, N. J. (p. 152)
 Magni-Power Co., Wooster, Ohio (p. 200)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

MAKE-UP AIR UNITS

Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)
 American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.
 Buffalo Forge Co., 490 Broadway, Buffalo 4, N. Y.
 De Vilbiss Co., Toledo, Ohio
 New York Blower Co., 3155 Shields Ave., Chicago 16, Ill.

MAN COOLING SYSTEMS

Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46 Calif. (p. 148)
 Robinson Ventilating Co., Zelienople Pa. (p. 283)
 Buffalo Forge Co., 490 Broadway, Buffalo 4, N. Y.
 Frazier-Simplex, Inc., 428 E. Beau St., Washington, Pa.
 General Glass Equipment Co., 5 S. Virginia Ave., Atlantic City, N. J.
 New York Blower Co., 3155 Shields Ave., Chicago 16, Ill.

MANGANESE, Compounds of

American Potash & Chem. Corp., 99 Park Ave., New York, N. Y. (p. 72)
 Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
 Foote Mineral Co., 436 Eighteen W. Cheltenham Bldg., Philadelphia 44, Pa. (p. 151)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
 Oglebay, Norton & Co., Hanna Bldg., Cleveland 15, Ohio (p. 231)
 Samuel & Co., Frank, Philadelphia Nat'l Bk Bldg., Philadelphia 7, Pa. (p. 264)
 Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

MANGANESE, High Carbon

Foote Mineral Co., Rm. 436, 18 W. Cheltenham Bldg., Philadelphia 44, Pa. (p. 151)
 Stoddy Co., 1134 W. Slauson Ave., Whittier, Calif.

MANGANESE STEEL

Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
 American Manganese Steel Div., 389 E. 14th, Chicago Heights, Ill.
 United States Steel Corp., 525 William Penn Pl., Pittsburgh 30, Pa.
 Vanadium Alloys Steel Co., Latrobe, Pa.

MANGLES

Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
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 International Engr., Inc., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
 Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
 Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 270, 271)
 Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

MARBLE DUST

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 United States Gypsum Co., 300 W. Adams St., Chicago 6, Ill. (p. 308, 309)
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MATERIAL HANDLING EQUIPMENT

Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)

Continental Gin Co., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)
 Garden City Fan Co., 801 N. Eighth St., Niles, Mich. (p. 153)
 Hendryx & Assoc., Dwight B., 6621 Darlington Rd., Pittsburgh 17, Pa. (p. 177)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 National Engineering Co., 549 W. Washington Blvd., Chicago 6, Ill. (p. 273, 274)
 Ohio Galvanizing & Mfg. Co., The, Niles, Ohio (p. 242)
 Pulverizing Machinery Div. Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
 Richards-Wilcox Mfg. Co., 240 Third St., Aurora, Ill. (p. 257)
 Spencer Turbine Co., 486 New Park Ave., Hartford 6, Conn. (p. 271)
 Syntrol Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
 Thayer Scale Co., 1 Thayer Park, Pembroke, Mass. (p. 303)

MERCURY

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 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Meriam Instrument Co., 10920 Madison Ave., Cleveland 2, Ohio (p. 209)
 Tennant, C., Sons & Co. of N. Y., 100 Park Ave., New York 17, N. Y. (p. 234-235)

METAL CLEANERS

(See Cleaners, Steel)

METAL DETECTORS, Electronic

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 14, Wis.
 Eriez Mfg. Co., Erie, Pa.
 General Electric Co., 1 River Rd., Schenectady 5, N. Y.

METAL FABRICATION

Cambridge Wire Cloth Co., Cambridge 11, Md. (p. 98)
 Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Ohio Galvanizing & Mfg. Co., The, Niles, Ohio (p. 242)
 Patterson-Kelly Co., Inc., The, East Stroudsburg, Pa. (p. 237-240)
 Stevenson Co., Wellsville 1, O. (p. 289-294)
 Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

METAL, Leaf

Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)

METAL MOLD CASES

Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

METAL POWDERS

Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
 Metal & Thermit Corp., Rahway, N. J. (p. 210, 211)
 New Jersey Zinc Co., 160 Front St., New York 38, N. Y. (p. 222)

METAL TIES, Cavity Wall

Copperweld Steel Co., Glassport, Pa.
 Rockford Fastener Co., P. O. Box 353, Rockford, Ill.

METALLIC SOAPS

Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
 Harshaw Chemical Co., 1945 97th, Cleveland 6, Ohio (p. 165)

CLASSIFIED DIRECTORY OF SUPPLIERS

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 McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, N. Y. 13, N. Y. (p. 320)

METERS, Electric

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Barber-Colman Co., Wheelco Instruments Div., 1300 Rock St., Rockford, Ill.
 Bristol Co., Waterbury 91, Conn.
 General Electric Co., 1 River Road, Schenectady 5, N. Y.
 Westinghouse Electric Corp., E. Pittsburgh, Pa.

METERS, Flow

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
 Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
 Meriam Instrument Co., The, 10920 Madison Ave., Cleveland 11, Ohio (p. 209)
 Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Steele, J. C., & Sons, Inc., Mulberry St., Stateville, N. C. (p. 284-287)
 Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)

METERS, Gas

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
 Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
 Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 National Engineering Co., 549 W. Washington Blvd., Chicago 6, Ill. (p. 273, 274)

METERS, Liquid

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
 Meriam Instrument Co., 10920 Madison Ave., Cleveland 2, Ohio (p. 209)
 Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 National Eng. Co., 549 W. Washington Blvd., Chicago 7, Ill. (p. 273, 274)
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MICA

Consolidated Feldspar Dept. of International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
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 Golding-Keene Co., 1401 New York Ave., Trenton 8, N. J. (p. 158)
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 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

MICROPROJECTORS

Brinkmann Instruments, Inc., 115 Cutter Mill Rd., Great Neck, N. Y.
 Mine Safety Appliance Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

MICROSCOPE STRAIN TESTERS

American Optical Co., Instruments Div., Eggert & Sugg Rds., Buffalo 21, N. Y.
 Brinkmann Instruments, Inc., 115 Cutter Mill Rd., Great Neck, N. Y.

MICROSCOPES

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)

See Their Catalogs for Complete Buying Information

Bausch & Lomb Optical Co., 635 St. Paul, Rochester 5, N. Y.
 Brinkmann Instruments, Inc., 115 Cutter Mill Rd., Great Neck, N. Y.
 Mine Safety Appliance Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

MILLS, Ball

Abbe, Paul O., 377 Center Ave., Little Falls, New Jersey (p. 62, 63)
 Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 American Porcelain Enamel Co., 1285 E. Keating Ave., Muskegon, Mich. (p. 169)
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 Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
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 Pereny Equipment Co., 893 Chambers Rd., Columbus 12, Ohio (p. 244, 245)
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 U. S. Stoneware Co., 12 East Ave., Tallmadge, Ohio (p. 311)
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MILLS, Balls and Linings for

Abbe, Paul O., 377 Center Ave., Little Falls, New Jersey (p. 62, 63)
 Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 Carborundum Co., Niagara Falls, N. Y. (p. 103-108, 110, 111)
 Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
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 International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 McDanel Refractory Porcelain Co., 510 Ninth Ave., Beaver Falls, Pa. (p. 206, 207)
 Orefraction, Inc., 7432 Thomas St., Pittsburgh 8, Pa. (p. 243)
 Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
 Pereny Equipment Co., 893 Chambers Rd., Columbus 12, Ohio (p. 244, 245)
 Stevenson Co., The, Wellsville, Ohio (p. 289-294)
 U. S. Stoneware Co., Process Equipment Div., 12 East Ave., Tallmadge, Ohio (p. 311)
 Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)
 Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 575 Madison Ave., New York 22, N. Y. (p. 322, 323)

MILLS, Chaser

Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
 Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Patterson Fdy. & Mach. Co., Helene St., East Liverpool, Ohio (p. 246, 247)
 Stevenson Co., The, Wellsville, Ohio (p. 289-294)

MILLS, Dust

American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
 Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
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 Patterson Fdy. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
 Pulverizing Machinery Div. Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
 Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 344)

MILLS, Hammer

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70-71)
 American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
 Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
 Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
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 Miller Equipment Co., Salisbury, N. C. (p. 214)
 Pulverizing Machinery Div. Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
 Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
 Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

MILLS, Jar

Abbe, Paul O., 377 Center Ave., Little Falls, N. J. (p. 62, 63)
 Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 American Porcelain Enamel Co., 1285 E. Keating Ave., Muskegon, Mich. (p. 169)
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 Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
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 McDanel Refractory Porcelain Co., 510 Ninth Ave., Beaver Falls, Pa. (p. 206, 207)
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 Pereny Equipment Co., 893 Chambers Rd., Columbus 12, Ohio (p. 244, 245)
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 Stevenson Co., The, Wellsville, Ohio (p. 289-294)
 U. S. Stoneware Co., 12 East Ave., Tallmadge, Ohio (p. 311)

MILLS, Laboratory

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ORSAT APPARATUS

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 General Electric Co., 1 River Rd., Schenectady 5, N. Y.
 Westinghouse Electric Corp., Sturtevant Division, 89 Broad, Boston 10, Mass.

POTASH

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POTASSIUM BICHROMATE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
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 International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
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 McGean Chemical Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
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POTASSIUM CARBONATE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
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POTASSIUM CHLORIDE

American Potash & Chemical Corp., 99 Park Ave., New York, N. Y. (p. 72)
 Consolidated Feldspar Dept., International Minerals & Chemical Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
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 Hommel Co., O., 209 Fourth Ave., Pittsburgh 30, Pa. (p. 178)
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 United States Borax & Chem. Co., 630 Shatto Place, Los Angeles 5, Calif. (p. 310)
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POTASSIUM CHROMATE

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 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
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 McGean Chemical Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
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POTASSIUM NITRATE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Drakenfeld & Co., B. F., 45-47 Park Place, New York 7, N. Y. (p. 137)
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 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
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POTASSIUM SILICO FLUORIDE

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POTENTIOMETERS, Hydrogen Ion

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POTENTIOMETERS, Pyrometer

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
 Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
 Miller Equip. Co., Inc., P. O. Box 1566, Salisbury, N. C. (p. 214)
 Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Pereny Equip. Co., 893 Chambers Rd., Columbus 12, Ohio (p. 244, 245)
 Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

POTTERY FRIT

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POTTERY MACHINERY

Bonnot Co., The, 721 Mulberry Rd. S. E., Canton 2, Ohio (p. 94)
 Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)
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 Miller Pottery Eng. Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
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POTTERY MACHINERY, Automatic

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International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
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 Miller Pottery Eng. Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
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POTTERY PLASTER

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 Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 United States Gypsum Co., 300 W. Adams St., Chicago 6, Ill. (p. 308, 309)
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POTTERY TOOLS

Crossley Machine Co., 301 Monmouth, Trenton 9, N. J. (p. 120, 121)
 Miller Pottery Eng. Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
 Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)

POWDER, Bleaching

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Olin Mathieson Chemical Corp., Industrial Chemicals Div., Baltimore 10, Md.
 Pennsalt Chem. Corp., 3 Penn Center, Philadelphia 2, Pa.

POWDER BLUE

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 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
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POWDER, Bronze

Drakenfeld & Co., B. F., 45-47 Park Place, New York 7, N. Y. (p. 137)
 Hommel Co., D., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
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POWDERED MATERIALS, Disintegrating

Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

POWDERED METALS

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 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical, 917 W. 18th St., Chicago 8, Ill. (p. 190)
 McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
 Metal & Thermit Corp., Rahway, N. J. (p. 210, 211)
 New Jersey Zinc Co., 160 Front St., New York 38, N. Y. (p. 222)

POWER SHOVELS

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POWER TRANSMISSION

(See items wanted)

PRECASTING CONVEYOR FOR SEWER PIPE

Star Fdy. & Mach. Co., New Lexington, O.

PRECIOUS METAL COATINGS

Hanovia Liquid Gold Div., 1 W. Central Ave., East Newark, N. J.

PREHEATERS, Air

Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)

PRESERVATIVES, Clay

Carbide & Carbon Chem. Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Vanderbilt Co., Inc., R. T., 230 Park Ave., New York 17, N. Y.

PRESSES, Artware

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Denison Engr. Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Ram, Inc., 1064 W. Fifth Ave., Columbus 8, Ohio (p. 251)

PRESSES, Brick Dry

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Chisholm Boyd & White Co., 610 W. 57th St., Chicago 21, Ill. (p. 125-136)
Denison Engineering Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, O. (p. 123)
Fernholtz Machinery Co., 8468D Melrose Pl., Los Angeles 46, Calif. (p. 148)
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Patterson Fdry. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Stevenson Co., The, Wellsville, Ohio (p. 289-294)

PRESSES, Briquetting

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Denison Engineering Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, O. (p. 123)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
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F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa. (p. 283)

PRESSES, Dinnerware

Crossley Machine Co., 301 Monmouth, Trenton 9, N. J. (p. 120, 121)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Ram, Inc., 1064 K. Fifth Ave., Columbus, Ohio (p. 251)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

PRESSES, Dry Molding

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Chisholm, Boyd & White Co., 610 W. 57th St., Chicago 21, Ill. (p. 125-136)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)

Denison Engineering Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Mch. Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
F. J. Stokes, 5500 Tabor Rd., Philadelphia 20, Pa., (p. 283)

PRESSES, Electrical Porcelain

Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120-121)
Denison Engineering Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, O. (p. 123)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Loomis Engineering & Mfg. Co., 126B S. 14th St., Newark, N. J. (p. 198)
Patterson Fdry. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Ram, Inc., 1064 W. Fifth Ave., Columbus, Ohio (p. 251)
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PRESSES, Extrusion

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Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112-113)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Loomis Eng. & Mfg. Co., Dept. CD, Route 46 & Clinton Rd., Caldwell, N. J. (p. 198)
Steele & Sons, Inc., Mulberry St., Statesville, N. C. (p. 284-287)

PRESSES, Filter

Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fernholtz Machinery Co., 8468D Melrose Pl., Los Angeles 46, Calif. (p. 148)
Fiedler, C. O., Inc., P. O. Box 15433, Vernon Branch, Los Angeles 58, Calif. (p. 150)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Foundry & Machine Co., The, 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Wahl Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

PRESSES, Glass

(See Glass Machines, Pressing)

PRESSES, Hot

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Wahl, A. J., Inc., 8 Central Ave., Brocton, N. Y. (p. 317)

PRESSES, Hydraulic

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PRESSES, Hydraulic Rotating Tool

Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Denison Engineering Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
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PRESSES, Insulator

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
International Clay Mch. Co., 1145 Bolander, Dayton 1, Ohio (p. 182, 183)
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PRESSES, Metal

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Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
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PRESSES, Refractory Shape

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
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Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
Hendryx, Dwight B., & Assoc., 6621 Darlington Rd., Pittsburgh 17, Pa. (p. 177)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Loomis Engineering & Mfg. Co., No. 22, Rte. 46 & Caldwell, N. J. (p. 198)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Ram, Inc., 1064 W. Fifth Ave., Columbus, Ohio (p. 251)
Stevenson Co., The, Wellsville, Ohio (p. 289-294)
Toronto Foundry & Machine Co., Trenton St., Toronto, Ohio (p. 306)

PRESSES, Sagger

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120-121)
Denison Engineering Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Stevenson Co., The, Wellsville, Ohio (p. 289-294)

PRESSES, Sewer Pipe

Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Stevenson Co., The, Wellsville, Ohio (p. 289-294)
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PRESSES, Specialty, Dry

Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Denison Engineering Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
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CLASSIFIED DIRECTORY OF SUPPLIERS

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., Helene St., East Liverpool, Ohio (p. 246, 247)

PRESSES, Steatite

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Denison Engineering Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
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PRESSES, Tile, Ceramic

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Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
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Ram, Inc., 1064 W. Fifth Ave., Columbus, Ohio (p. 251)

PRESSING MACHINES, Plastic

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PRESSURE GAGES

(See Gages, Pressure)

PRINTING MACHINES

Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
Hagerman, Lawrence, 9048 E. Telegraph Rd., Rivera, Calif.
Sneyd Color Co., 218 Cook Bldg., Cleveland 3, Ohio

PRINTING OILS

(See Oils and Mediums)

PROPANE

American Liquid Gas Corp., 1109 S. Santa Fe Ave., Los Angeles, Calif.
Pacific Gas Corp., 630 5th Ave., New York 20, N. Y.
Phillips Petroleum Co., 2126 National Bank Bldg., Detroit 26, Mich.
Pure Oil Co., 35 E. Wacker Dr., Chicago 1, Ill.
Sinclair Oil and Gas Co., Sinclair Bldg., Tulsa, Okla.

PROPORTIONING EQUIPMENT, Batch

Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Syntrol Co., 750 Lexington, Homer City, Pa. (p. 296)
Jeffrey Manufacturing Co., 913 N. Fourth St., Columbus 16, Ohio

PSYCHROMETERS

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)

PUG MILLS

American Clay Machinery Div. of Huber-Warco Co., P. O. Box 501, 202 N. Greenwood St., Marion, Ohio (p. 76-77)
Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
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International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
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Continental Gin Co., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)
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International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Toronto Foundry & Machine Co., Trenton St., Toronto, Ohio (p. 306)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)
Worthington Corp., S. 2nd St., Plainfield, N. J. (p. 324)

PULLEYS, Magnetic

Continental Gin Co., Industrial Div., 4500 5th Ave. So., Birmingham 2, Alabama (p. 119)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Magni-Power Co., Wooster, Ohio (p. 200)
Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.
Dings Magnetic Separator Co., 4740 W. McGeoch Ave., Milwaukee 14, Wis.
Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

PULLEYS, Variable Speed

Continental Gin Co., Industrial Div., 4500 5th Ave. S., Birmingham 2, Ala. (p. 119)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
Wahl, A. J., Inc., 8 Central Ave., Brocton, N. Y. (p. 317)
Worthington Corp., S. 2nd St., Plainfield, N. J. (p. 324)

PULVERIZERS

(See also Crushers—Various Types, Disintegrators, Grinders and Mills, Pulverizing)
Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
Hendryx, Dwight B., & Assoc., 6621 Darlington Rd., Pittsburgh 17, Pa. (p. 177)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Sturtevant Mill Co., 6 Harrison Sq., Dorchester, Boston, Mass. (p. 288)
Williams Patent Crusher & Pulverizer Co., 2701 N. Broadway, St. Louis 6, Mo. (p. 321)

PULVERIZERS, Air Separation

Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Pulverizing Machinery, Div. Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Sturtevant Mill Co., 6 Harrison Sq., Boston 22, Mass. (p. 288)
Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

PULVERIZERS, Screw Feed

American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Pulverizing Machinery Div. Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
William Patent Crusher & Pulverizer Co., 2701 N. Broadway, St. Louis 6, Mo. (p. 321)

PUMICE

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

PUMPS, Acid & Alkaline Solution

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)

PUMPS, Centrifugal

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
Binks Mfg. Co., 3114-44 Carroll Ave., Chicago 12, Ill. (p. 91)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Steele & Sons, Inc., J. C., Statesville, N. C. (p. 284-287)
Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)

PUMPS, Diaphragm

Crossley Mach. Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
International Engr., Inc., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Gates Rubber Co., 1045 S. Broadway, Denver 17, Colo.

PUMPS, Filter Press

(See Pumps, Slip)

PUMPS, Gas

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Worthington Corp., So. 2nd St., Plainfield, N. J. (p. 324)
Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 14, Wis.
Schurs Oil Burner Co., 8500 Zamore Ave., Los Angeles 1, Calif.

PUMPS, Hydraulic Press

Denison Engr. Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)
Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

CLASSIFIED DIRECTORY OF SUPPLIERS

PUMPS, Oil

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 W. N. Best Combustion Equip. Co., 415 11th St., Carlstadt, N. J. (p. 90)
 Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Denison Engr. Co., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
 Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
 Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
 Hauck Mfg. Co., 138-143 Tenth St., Brooklyn 15, N. Y. (p. 168)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
 Steele, J. C., & Sons, Inc., Mulberry St., Stateville, N. C. (p. 284-287)
 Syntrol Co., 750 Lexington, Homer City, Pa. (p. 296)
 Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)

PUMPS, Rotary

Best, W. N. Combustion Equip. Co., 415 11th St., Carlstadt, N. J. (p. 90)
 Binks Mfg. Co., 3114-44 Carroll Ave., Chicago 12, Ill. (p. 91)
 Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Worthington Corp., So. 2nd St., Plainfield, N. J. (p. 324)

PUMPS, Rotary Shaft Seals Replacement Forms

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 Syntrol Co., 750 Lexington, Homer City, Pa. (p. 296)

PUMPS, Slip

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Fernholtz Mach. Co., 8468D Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
 Fiedler, C. O., Inc., 221 E. 37th St., Los Angeles 58, Calif. (p. 150)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)

PUMPS, Sludge

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
 Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)

PUMPS, Sump

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)
 Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

PUMPS, Vacuum

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio, and Marion, Ohio (p. 76, 77)
 Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
 Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
 Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Steele & Sons, Inc., J. C., Mulberry St., Stateville, N. C. (p. 284-287)
 F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa. (p. 283)
 Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)

PYROMETERS, Optical

Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
 Pereny Equipment Co., 893 Chambers Rd., Box 153 Stn. A, Columbus 12, Ohio (p. 244, 245)

PYROMETERS, Portable

Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
 Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
 Minneapolis-Honeywell Regulator Co. Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Pereny Equipment Co., 893 Chambers Rd., Box 153 Stn. A, Columbus 12, Ohio (p. 244, 245)

PYROMETERS, Potentiometer

(See Potentiometers, Pyrometer)

PYROMETERS, Radiation

Harrop Ceramic Supply Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
 Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
 Minneapolis-Honeywell Regulator Co. Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Pereny Equipment Co., 893 Chambers Rd., Box 153 Stn. A, Columbus 12, Ohio (p. 244, 245)

PYROMETERS, Thermoelectric, Indicating and Recording

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
 Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
 Minneapolis-Honeywell Regulator Co. Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Pereny Equipment Co., 893 Chambers Rd., Box 153 Stn. A, Columbus 12, Ohio (p. 244, 245)

PYROPHYLLITE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Glendon Pyrophyllite Co., P. O. Box 2414, Greensboro, N. C. (p. 157)
 Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 North State Pyrophyllite Co., 508 Rucker St., Greensboro, N. C. (p. 224)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

QUARTZ

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Consolidated Feldspar Dept. of International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
 Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 International Minerals & Chemical Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
 McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
 Norton Co., 1 New Bond, Worcester 6, Mass. (p. 225-230)
 Pennsylvania Glass Sand Corp., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)

Pennsylvania Pulverizing Co., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
 Pioneer Silica Products Co., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

RACKS, Drying

Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
 Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
 Fiedler, C. O., Inc., 221 E. 37th St., Los Angeles 58, Calif. (p. 150)
 Besser Co., Box 314, Alpena, Mich.
 Chase Foundry & Mfg. Co., 2300 Parsons, Columbus 7, Ohio

RACKS, Placing

Carborundum Co., Hyde Park Blvd., Niagara Falls, N. Y. (p. 103-108)
 Louthan Mfg. Co., Subsidiary of Ferro Corp., 2000 Harvey Ave., East Liverpool, Ohio (p. 194-196)
 New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
 Norton Co., 1 New Bond, Worcester 6, Mass. (p. 225-230)
 Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)

RADIANT TUBE FURNACES and KILNS

Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
 Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)
 Swindell-Dressler Corp., P. O. Box 1888, Pittsburgh 30, Pa. (p. 275-282)

RAIL and TRACK EQUIPMENT

International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Metal & Thermit Corp., Rahway, N. J. (p. 210, 211)
 Richards-Wilcox Mfg. Co., 2176 Third St., Aurora, Ill. (p. 257)

RAMPS

Flink Co., The, Streator, Ill.

RARE EARTHS

Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Heavy Minerals Co., 4000 N. Hawthorne St., Chattanooga, Tenn. (p. 174, 175)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Lindsay Chemical Co., Div. American Potash & Chem. Corp., 250 Ann St., West Chicago, Ill. (p. 72)

RECONDITIONED EQUIPMENT

Chambers Bros. Co., 52nd & Media St., Philadelphia 21, Pa. (p. 112, 113)
 Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.

RECORDERS, CO and CO₂

Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
 Leeds & Northrup Co., 4914 Stenton Ave., Columbus 15, Ohio (p. 193)
 Surface Combustion Co., 2375 Dorr St., Toledo 1, Ohio (p. 295)

CLASSIFIED DIRECTORY OF SUPPLIERS

RECORDERS, Draft

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)

RECORDERS, Humidity

Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)

RECORDERS, Liquid Level

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)

RECORDERS, Pressure

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
Pereny Equipment Co., 893 Chambers Rd., Box 153, Stn. A, Columbus 12, Ohio (p. 244, 245)

RECORDERS, Temperature

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa. (p. 193)
Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
Pereny Equip. Co., 893 Chambers Rd., Columbus 12, Ohio (p. 244, 245)
Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)

RECTIFIERS

Syntrox Co., 750 Lexington Ave., Homer City, Pa. (p. 322)
General Electric Co., 1 River Rd., Schenectady 5, N. Y.

RECUPERATORS, Refractory

Carborundum Co., Niagara Falls, N. Y. (p. 103-108)
Ferro Corp., 450 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Harbison-Walker Refr. Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162, 163)
New Castle Refractories Co., S. Swansea, New Castle, Pa. (p. 218-221)
Norton Co., 1 New Bond, Worcester 6, Mass. (p. 225-230)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)

REDUCERS, Speed

(See Transmission, Variable Speed)

REFRACTOMETERS

American Optical Co., Instruments Div., Eggert & Optical Rds., Buffalo 21, N. Y.

Brinkmann Instruments, Inc., 115 Cutter Mill Rd., Great Neck, N. Y.

REFRACTORIES

Armstrong Cork Co., Liberty and Charlotte Sts., Lancaster, Pa. (p. 80)
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Carborundum Co., Niagara Falls, N. Y. (p. 103-108)
Ceramic Supply Co., Div. Ferro Corp., Box 151, Crooksville, Ohio (p. 65-68)
Eagle-Picher Co., American Bldg., Cincinnati 1, Ohio (p. 141)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Gem Clay Forming, Inc., Box 500, Sebring, Ohio (p. 156)
Harbison-Walker Refr. Co., 1800 Farmers Bank Bldg., Pittsburgh 22, Pa. (p. 162, 163)
Haws Refractories Co., 407 Main St., Johnstown, Pa. (p. 176)
Illinois Clay Products Co., Barber Bldg., Joliet, Ill. (p. 180)
Johns-Manville, 22 E. 40th St., New York 16, N. Y. (p. 184, 185)
Louthan Mfg. Co., Subsidiary of Ferro Corp., 2000 Harvey Ave., East Liverpool, Ohio (p. 194-196)
Miller Equip. Co., Inc., P. O. Box 1566, Salisbury, N. C. (p. 214)
New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
North State Pyrophyllite Co., 508 Rucker St., Greensboro, N. C. (p. 224)
Norton Co., 1 New Bond, Worcester 6, Mass. (p. 225-230)
Orefraction, Inc., 7432 Thomas St., Pittsburgh 8, Pa. (p. 243)
Remmey Son Co., Richard C., Hedley St. & Delaware Riv., Philadelphia 37, Pa. (p. 252-255)
Samuel, Frank, & Co., Philadelphia National Bank Bldg., Philadelphia 7, Pa. (p. 264)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
Universal Atlas Cement Co., Lumnite Div., 100 Park Ave., New York 17, N. Y. (p. 313-316)
Wellsville Fire Brick Co., Wellsville, Mo. (p. 318)
Zirconium Corp. of America, P. O. Box 196, Solon, Ohio (p. 325)

REFRACTORIES, Aluminum Oxide

Carborundum Co., The, Niagara Falls, N. Y. (p. 103-108)
Electro Refr. & Abr. Corp., 344 Delaware Ave., Buffalo 2, N. Y. (p. 144)
Harbison-Walker Refractories Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162-163)
Norton Co., Worcester 6, Mass. (p. 225-230)
Remmey, Son Co., Richard C., Hedley St. & Delaware River, Philadelphia 37, Pa. (p. 252-255)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
Wellsville Fire Brick Co., Wellsville, Mo. (p. 318)

REFRACTORIES, BASIC

Electro Refractories & Abrasives Corp., 344 Delaware Ave., Buffalo 2, N. Y. (p. 144)
Harbison-Walker Refr. Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162, 163)
Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
Samuel, Frank, & Co., Philadelphia National Bank Bldg., Philadelphia 7, Pa. (p. 264)
Kaiser Chem. Div., Kaiser Aluminum Chem. Sales, Inc., 1924 Broadway, Oakland 12, Calif.

REFRACTORIES, Glass House

(See Tank Blocks)

REFRACTORIES, Insulating

Armstrong Cork Co., 950 Mulberry St., Lancaster, Pa. (p. 80)
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Carborundum Co., Niagara Falls, N. Y. (p. 103-108)
Eagle-Picher Co., American Bldg., Cincinnati 1, Ohio (p. 141)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Gem Clay Forming, Inc., Box 500, Sebring, Ohio (p. 156)
Harbison-Walker Refr. Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162, 163)

Illinois Clay Products Co., Barber Bldg., Joliet, Ill. (p. 180)
Johns-Manville, 22 East 40th St., New York 16, N. Y. (p. 184, 185)
Louthan Mfg. Co., Subsidiary of Ferro Corp., 2000 Harvey Ave., East Liverpool, O. (p. 194-196)
McDaniel Refractory Porcelain Co., 500 Ninth Ave., Beaver Falls, Pa. (p. 206, 207)
New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
North State Pyrophyllite Co., 508 Rucker St., Greensboro, N. C. (p. 224)
Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
Remmey Son Co., Richard C., Hedley St. & Delaware Riv., Philadelphia 37, Pa. (p. 252-255)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
Universal Atlas Cement Co., Lumnite Div., 100 Park Ave., New York 17, N. Y. (p. 313-316)

REFRACTORIES, Mullite

Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Carborundum Co., The, Refractories Div., Perth Amboy, N. J. (p. 103-108)
Electro Refr. & Abr. Corp., 344 Delaware Ave., Buffalo 2, N. Y. (p. 144)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Harbison-Walker Refr. Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162, 163)
New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
Remmey Son Co., Richard C., Hedley St. & Delaware Riv., Philadelphia 37, Pa. (p. 252-255)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)

REFRACTORIES, Plastic

Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Carborundum Co., Niagara Falls, N. Y. (p. 103-108)
Eagle-Picher Co., American Bldg., Cincinnati 1, Ohio (p. 141)
Harbison-Walker Refr. Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162, 163)
Illinois Clay Products Co., Barber Bldg., Joliet, Ill. (p. 180)
Johns-Manville, 22 East 40th St., New York 16, N. Y. (p. 184, 185)
New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
North State Pyrophyllite Co., 508 Rucker St., Greensboro, N. C. (p. 224)
Remmey Son Co., Richard C., Hedley St. & Delaware Riv., Philadelphia 37, Pa. (p. 252-255)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
Wellsville Fire Brick Co., Wellsville, Mo. (p. 318)

REFRACTORIES, Silica

Harbison-Walker Refr. Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162, 163)
Haws Refractories Co., 407 Main St., Johnstown, Pa. (p. 176)
Illinois Clay Products Co., Barber Bldg., Joliet, Ill. (p. 180)
Johns-Manville, 22 E. 40th St., New York 16, N. Y. (p. 184, 185)
McDaniel Refractory Porcelain Co., 500 Ninth Ave., Beaver Falls, Pa. (p. 206, 207)
Patterson Fdry. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)

REFRACTORIES, Silicon Carbide

Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Carborundum Co., The, Niagara Falls, N. Y. (p. 103-108)
Electro Refr. & Abr. Corp., 344 Delaware Ave., Buffalo 2, N. Y. (p. 144)
Exolon Co., The, 941 E. Niagara St., Tonawanda, N. Y. (p. 142, 143)
Harbison-Walker Refractories Co., 307 5th Avenue, Pittsburgh 22, Pa. (p. 162, 163)
New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
Pereny Equipment Co., 893 Chambers Rd., Box 153, Stn. A, Columbus 12, Ohio (p. 244, 245)

Remmey Son Co., Richard C., Hedley St. & Delaware Riv., Philadelphia 37, Pa. (p. 252-255)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)

REFRACTORIES, Zircon

Carborundum Co., Niagara Falls, N. Y. (p. 103-108)
New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
Orefraction, Inc., 7432 Thomas St., Pittsburgh 8, Pa. (p. 233)
Remmey Son Co., Richard C., Hedley St. & Delaware Riv., Philadelphia 37, Pa. (p. 252-255)
Shenango Refractories Div. of Shenango China, Inc., Box 120, New Castle, Pa. (p. 268)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
Titanium Alloy Mfg. Div., National Lead Co., 111 Broadway, New York 6, N. Y. (p. 299-302)

REFRACTORY CEMENT

(See Cements, High Temperature)

REGULATORS, Air

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)

REGULATORS, Gas and Oil

(See Controllers, Gas and Oil)

REGULATORS, Humidity

(See Controllers, Humidity)

REGULATORS, Pressure

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
Hauck Mfg. Co., 133-143 Tenth St., Brooklyn 15, N. Y. (p. 168)
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REGULATORS, Speed, Variable

Worthington Corp., 401 Worthington Ave., Holyoke, Mass. (p. 324)
Barber-Colman Co., Wheelco Instruments Div., 1300 Rock St., Rockford, Ill.
General Electric Co., 1 River Rd., Schenectady 5, N. Y.
Link-Belt Co., Dept. CDBL-58 Prudential Plaza, Chicago 1, Ill.

REGULATORS, Temperature

(See Controllers, Temperature)

REGULATORS, Voltage and Frequency

Allis-Chalmers Mfg. Co., 862 S. 70th St., Milwaukee 1, Wis.
General Electric Co., 1 River Rd., Schenectady 5, N. Y.

REPRESSES

American Clay Machinery Div. of Huber-Warco Co., 202 N. Greenwood St., P. O. Box 501, Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)

Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

RESPIRATORS

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)
DeVilbiss Co., The, 300 Phillips, Toledo 1, Ohio
Ton-Tex Corp., 247 Pearl St., N. W., Grand Rapids, Mich.

RESIN

Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)
Raybestos-Manhattan, Inc., Bridgeport 2, Conn.

RODS, Nickel & Nickel Alloys

Coast Metals, Inc., P. O. Box #7, Little Ferry, N. J. (p. 115)
International Nickel Co., Inc., The, 67 Wall St., New York 5, N. Y.

RODS, Welding

Coast Metals, Inc., P. O. Box #7, Little Ferry, N. J. (p. 115)
Colorado Fuel & Iron Corp., The, 575 Madison Ave., New York 22, N. Y. (p. 322-323)
Metal & Thermit Corp., Rahway, N. J. (p. 230, 231)
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 361 Delaware Ave., Buffalo 2, N. Y. (p. 322, 323)
American Brake Shoe Co., 230 Park Ave., New York 17, N. Y.
International Nickel Co., Inc., The, 67 Wall St., New York 5, N. Y.
Stoody Co., 1134 W. Slauson Ave., Whittier, Calif.

ROLL CRUSHERS

Abbe Eng. Co., 50 Church St., New York, N. Y. (p. 70, 71)
American Clay Machinery Div. of Huber-Warco Co., 202 N. Greenwood, Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Posey Iron Works, Inc., Brick Mch. & Mixer Div., Lancaster, Pa. (p. 248)
Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Stevenson Co., Wellsville, Ohio (p. 289-294)
Sturtevant Mill Co., 6 Harrison Sq., Dorchester, Boston, Mass. (p. 288)

ROLL CRUSHERS and SHELLS

American Clay Mach. Co., Div. of Huber-Warco Co., 202 N. Greenwood, Marion, Ohio (p. 76, 77)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Posey Iron Works, Inc., Brick Mch. & Mixer Div., Lancaster, Pa. (p. 248)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Stevenson Co., Wellsville, Ohio (p. 289-294)

ROLLER MILLS

Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

ROLLS, Conical

(See also Crushers, Roll)

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Bonnot Co., The, 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
Chambers Brothers Co., 52nd and Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

ROLLS, Fine Grinding

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio, and Marion, Ohio (p. 76, 77)
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Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Sturtevant Mill Co., 6 Harrison Sq., Dorchester, Boston, Mass. (p. 288)

ROOFING AND SIDING

Armstrong Cork Co., Liberty and Charlotte Sts., Lancaster, Pa. (p. 80)
Bestwall-Certain-Teed Sales Corp., 120 E. Lancaster Ave., Ardmore, Pa. (p. 86, 87)
Johns-Manville, 22 East 40th St., New York 16, N. Y. (p. 184, 185)
New Jersey Zinc Co., 160 Front St., New York 7, N. Y. (p. 222)
United States Gypsum Co., 300 W. Adams St., Chicago 6, Ill. (p. 308, 309)

ROOFING TILE MACHINES

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio, and Marion, Ohio (p. 76, 77)
Chambers Brothers Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)

ROPE, Wire

Wickwire Spencer Steel Div., Colo. Fuel & Iron Corp., 575 Madison Ave., New York 22, N. Y. (p. 322, 323)
Leschen Wire Rope Div., 5909 Kennerly Ave., St. Louis 12, Mo.
Ton-Tex Corp., 247 Pearl St., N. W., Grand Rapids 2, Mich.

ROSIN

(See Resin)

ROTARY DRYERS

(See Dryers, Rotary)

ROTARY FURNACES FOR GLASS

Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio. (p. 295)
Harper Electric Furnace Corp., 39 River St., Buffalo 2, N. Y.
Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.

ROTARY KILNS

Bonnot Co., 721 Mulberry Rd., S. E., Canton 2, Ohio (p. 94)
 Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
 Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
 Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
 Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)

ROUGE

Columbian Carbon Co., Mapico Color Unit, 601 Cass St., Trenton 10, N. J. (p. 116)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

RUBBER GOODS MOLDED

Armstrong Cork Co., Liberty and Charlotte St., Lancaster, Pa. (p. 80)
 Johns-Manville, 22 East 40th St., New York 16, N. Y. (p. 184, 185)
 U. S. Stoneware Co., Tallmadge Ave., Akron 9, Ohio (p. 311)
 Raybestos-Manhattan, Inc., 61 Willett, Passaic, N. J.

RUST PREVENTATIVES

Metal & Thermit Corp., Rahway, N. J. (p. 210, 211)
 American Chemical Paint Co., Ambler, Pa.
 Specialty Products Co., 190 Warren St., Jersey City 2, N. J.

RUTILE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
 Foote Mineral Co., Rm. 436, Eighteen W. Cheltenham Bldg., Philadelphia 44, Pa. (p. 151)
 Heavy Minerals Co., 4000 N. Hawthorne St., Chattanooga, Tenn. (p. 174, 175)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Metal & Thermit Corp., Rahway, N. J. (p. 210, 211)
 Oretraction, Inc., 7432 Thomas St., Pittsburgh 8, Pa. (p. 243)
 Samuel & Co., Frank, 2200 Philadelphia National Bk. Bldg., Philadelphia 7, Pa. (p. 264)
 Tennant, C., Sons & Co. of N. Y., 100 Park Ave., New York 17, N. Y. (p. 234, 235)
 Titanium Alloy Mfg. Div., 111 Broadway, New York 6, N. Y. (p. 299-302)

SAFETY EQUIPMENT & CLOTHING

Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
 Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Johns-Manville, 22 East 40th St., New York 16, N. Y. (p. 184, 185)
 Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)

SAGGER CLAY

(See Clays, Sagger)

SAGGERS

Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
 Ceramic Supply Co., Div. Ferro Corp., Box 151, Crooksville, Ohio (p. 65-68)
 Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)

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Gem Clay Forming, Inc., Box 500, Sebring, Ohio (p. 156)
 Louthan Mfg. Co., Subsidiary of Ferro Corp., 2000 Harvey Ave., East Liverpool, Ohio (p. 194-196)
 New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
 Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
 Potters Supply Co., 11 Washington, P. O. Box 746, East Liverpool, Ohio (p. 249)
 Remmey Son Co., Richard C., Hedley St. & Delaware Riv., Philadelphia 37, Pa. (p. 252-255)
 Shenango Refractories, Div. of Shenango China, Inc., P. O. Box 120, New Castle, Pa. (p. 268)
 Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
 Titanium Alloy Mfg. Div., National Lead Co., 111 Broadway, New York 6, N. Y. (p. 299-302)

SALT CAKE

American Potash & Chemical Corp., 99 Park Ave., New York, N. Y. (p. 72)
 Ceramic Color & Chem. Mfg. Co., New Brighton, Pa. (p. 100)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 Stauffer Chemical Co., 380 Madison Ave., New York 17, N. Y. (p. 272)

SALT TABLETS AND DISPENSERS

Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

SALTPETER

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
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 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)

SALTS, Etching

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)

SAND

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SAND BEDDING MACHINES,

Automatic

Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

SAND BLAST EQUIPMENT

Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
 Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

SAND, Blasting

Cabot, Godfrey L., Inc., 77 Franklin St., Boston 10, Mass. (p. 101, 102)
 Continental Silica Co., P. O. Box 124, Somonauck, Ill. (p. 122)
 Pennsylvania Glass Sand Corp., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
 Titanium Alloy Mfg. Div., National Lead Co., 111 Broadway, New York 6, N. Y. (p. 299-302)
 Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio
 Shieldalloy Corp., Newfield, N. J.
 Silica Products Co., Inc., Guion, Arkansas

SAND, Drying

Langly Co., 2800 Euclid Ave., Cleveland 15, Ohio (p. 201-204)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. (p. 223)
 Pennsylvania Glass Sand Corp. of Oklahoma, Mill Creek, Okla. (p. 241)
 Pennsylvania Glass Sand Corp., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
 Pangborn Corp., 297 Pangborn Bldg., Hagerstown, Md.
 Silica Products Co., Box 248, Guion, Ark.

SAND, Placing

Consolidated Feldspar Dept. of International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
 Continental Silica Co., P. O. Box 124, Somonauck, Ill. (p. 122)
 Pennsylvania Glass Sand Corp., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
 Pennsylvania Glass Sand Corp. of Oklahoma, 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
 Pioneer Silica Products Co., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
 Tavern Rock Sand Co., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)

SAPONINE

Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 188)
 Croxall Chemical & Supply Co., P. O. Box 757, East Liverpool, Ohio

SAWDUST

Shavings and Sawdust Co., 308 W. Washington, Chicago 6, Ill.

SAWS, Abrasive

Blanchard Machine Co., 64 State St., Cambridge 39, Mass. (p. 92, 93)
 Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
 Cardinal Engineering Corp., 144 Burnside St., Philadelphia 77, Pa.
 Champion Mfg. Co., 2028 Washington, St. Louis 3, Mo.
 Clipper Mfg. Co., 2819 Warwick, Kansas City 8, Mo.
 Raybestos-Manhattan, Inc., 61 Willett Ave., Passaic, N. J.

SCALE SYSTEMS

Thayer Scale Co., 1 Thayer Park, Pembroke, Mass. (p. 303)

SCALES

Thayer Scale Co., 1 Thayer Park, Pembroke, Mass. (p. 303)
 Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.
 Brinkmann Instruments, Inc., 115 Cutter Mill Rd., Great Neck, N. Y.
 Toledo Scale Co., 1045 Telegraph Rd., Toledo 12, Ohio

SCALES, Automatic Conveyor

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Schaffer Poidometer Co., 2525 Smallman St., Pittsburgh 22, Pa. (p. 265)
 Syntrol Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
 Thayer Scale Co., 1 Thayer Park, Pembroke, Mass. (p. 303)
 Dwight-Lloyd, Inc., Div., McDowell Co., Inc., 16300 Waterloo Rd., Cleveland 10, Ohio
 Toledo Scale Co., 1045 Telegraph Rd., Toledo 12, Ohio

SCALES, Hopper

Thayer Scale Co., 1 Thayer Park, Pembroke, Mass. (p. 303)
 Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.
 Toledo Scale Co., 1045 Telegraph Rd., Toledo 12, Ohio

SCALES, Proportioning

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Schaffer Poidometer Co., 2525 Smallman St., Pittsburgh 22, Pa. (p. 265)
 Syntron Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
 Thayer Scale Co., 1 Thayer Park, Pembroke, Mass. (p. 303)
 Dwight-Lloyd, Inc., Div., McDowell Co., Inc., 16300 Waterloo Rd., Cleveland 10, Ohio
 Toledo Scale Co., 1045 Telegraph Rd., Toledo 12, Ohio

SCOVE KILN INSULATION

(See Insulation, Scove Kiln)

SCRAPERS, Dragline

(See Draglines)

SCRAPERS, Sanitary

Milligan Hardware & Supply Co., The, 115, 117 E. 5th St., East Liverpool, Ohio

SCRAPERS, Tractor

(See Tractor Scrapers)

SCRAPERS, Wheeled

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 14, Wis.
 Caterpillar Tractor Co., 600 W. Washington, Peoria 8, Ill.

SCRATCHERS, Brick

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 Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
 International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
 Steele & Sons, Inc., J. C., Mulberry St., Stateville, N. C. (p. 284-287)

SCREEN CLOTH

(See Wire Screening Cloth, Nylon Screening Cloth and Cloth, Bolting)

SCREEN PLATES

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 Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
 Chambers Bros., Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
 Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Steele & Sons, Inc., J. C., P. O. Box 951, Stateville, N. C. (p. 284-287)
 Stevenson Co., Wellsville, Ohio (p. 289-294)
 Toronto Foundry & Machine Co., Trenton St., Toronto, Ohio (p. 306)

SCREENS, Electric Heating

Deister Concentrator Co., 933 Glasgow Ave., Ft. Wayne 4, Ind. (p. 138, 139)
 Fernholtz Machinery Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Hendryx & Assoc., Dwight B., 6621 Darlington Rd., Pittsburgh 17, Pa. (p. 177)
 Tyler Co., W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
 Universal Vibrating Screen Co., Racine, Wis. (p. 312)

SCREENS, Laboratory

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 Crossley Mach. Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)

Deister Concentrator Co., 933 Glasgow Ave., Ft. Wayne 4, Ind. (p. 138, 139)
 Fernholtz Machinery Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 International Clay Mch. Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Patterson Fdry. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
 Stevenson Co., Wellsville, Ohio (p. 289-294)
 Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
 Tyler Co., The, W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
 Universal Vibrating Screen Co., 1745 Deane Blvd., Racine, Wis. (p. 312)
 Williams Patent Crusher & Pulverizer Co., 2701 N. Broadway, St. Louis 6, Mo. (p. 321)

SCREENS, Liquid

Deister Concentrator Co., 933 Glasgow Ave., Ft. Wayne 4, Ind. (p. 138, 139)
 Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
 Fernholtz Machinery Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
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 Tyler Co., The, W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
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SCREENS, Perforated Metal

Abbe Eng. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 575 Madison Ave., New York 22, N. Y. (p. 322, 323)
 Williams Patent Crusher & Pulverizer Co., 2701 N. Broadway, St. Louis 6, Mo. (p. 321)
 Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.
 Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 14, Wis.
 Great Western Mfg. Co., 208-220 Choctaw St., Leavenworth, Kans.
 Jeffrey Manufacturing Co., 913 N. Fourth St., Columbus 16, Ohio
 Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

SCREENS, Portable (Vibrating)

Deister Concentrator Co., 933 Glasgow Ave., Ft. Wayne 4, Ind. (p. 138, 139)
 Exolon Co., The, 941 E. Niagara St., Tonawanda, N. Y. (p. 142, 143)
 Fernholtz Machinery Co., 8468D Melrose Pl., Los Angeles 46, Calif. (p. 148)
 Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
 Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Patterson Fdry. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
 Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
 Tyler Co., W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
 Universal Vibrating Screen Co., 1745 Deane Blvd., Racine, Wis. (p. 312)
 Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 575 Madison Ave., New York 22, N. Y. (p. 322, 323)
 Williams Patent Crusher & Pulverizing Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

SCREENS, Revolving

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
 Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
 Fernholtz Mach. Co., 8468 Melrose Place, Los Angeles 46, Calif. (p. 148)

Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 National Engineering Co., 602 Machinery Hall Bldg., Chicago 6, Ill. (p. 273, 274)
 Patterson Fdry. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
 Stevenson Co., Wellsville 1, Ohio (p. 289-294)
 Tyler Co., W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)

SCREENS, Silk

Abbe, Paul O., 377 Center Ave., Little Falls, N. J. (p. 62, 63)
 Abbe Engr. Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Patterson Fdry. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)

SCREENS, Vibrating

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
 Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
 Cambridge Wire Cloth Co., Cambridge, Md. (p. 98)
 Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Deister Concentrator Co., 933 Glasgow Ave., Ft. Wayne 4, Ind. (p. 138, 139)
 Exolon Co., The, 941 E. Niagara St., Tonawanda, N. Y. (p. 142, 143)
 Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
 Hendryx & Assoc., Dwight B., 6621 Darlington Rd., Pittsburgh 17, Pa. (p. 177)
 Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
 National Engineering Co., 602 Machinery Hall Bldg., Chicago 6, Ill. (p. 273, 274)
 Patterson Fdry. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
 Stevenson Co., Wellsville, Ohio (p. 289-294)
 Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
 Syntron Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
 Tyler Co., W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
 Universal Vibrating Screen Co., 1745 Deane Blvd., Racine, Wis. (p. 312)
 Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 575 Madison Ave., New York 22, N. Y. (p. 322, 323)
 Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

SCREENS, Wedge Wire

Abbe Engineering Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
 Cambridge Wire Cloth Co., The, Washington Blvd., Cambridge, Md. (p. 98)
 Tyler Co., W. S., 3614 Superior Ave., Cleveland 14, Ohio (p. 307)
 Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., Continental Oil Building, Denver 1, Colo. (p. 322, 323)

SCRUBBERS, Sand and Stone

Carborundum Co., Niagara Falls, N. Y. (p. 103-108, 110, 111)
 Harding Co., Inc., 240 Arch St., York, Pa. (p. 164)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Tyler Co., W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
 Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 14, Wis.
 Eagle Iron Works, 129 Holcomb Ave., Des Moines 13, Iowa
 Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

SCUM PREVENTION, in Clay

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Chicago Copper & Chem. Co., 127th & Division, Blue Island, Ill. (p. 109)

CLASSIFIED DIRECTORY OF SUPPLIERS

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Minerva Oil Co., Eldorado, Ill. (p. 217)
Oglebay, Norton & Co., Hanna Bldg., Cleveland 15, Ohio (p. 231)
Rosiclar Lead & Fluorspar Mining, Rosiclar, Ill. (p. 262)

SELENIUM, Compounds of

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Drakenfeld & Co., B. F., 45 Park Pl., New York 7, N. Y. (p. 137)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

SEMI-CONDUCTORS

Merck, Sharpe & Dohme Div., 15 Lincoln Ave., Rahway, N. J.
Monsanto Chemical Co., Inorganic Chem. Div., Lindbergh & Olive St., Rd., St. Louis 24, Mo.
Ohio Semi-Conductors, Inc., 1035 W. 3rd Ave., Columbus 8, Ohio
U. S. Semi-Conductor Products, Inc., 3536 W. Osborn Rd., Phoenix, Ariz.

SEPARATORS, Air

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Ducon Co., The, 149 E. 2nd St., Mineola, N. Y. (p. 140)
Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Spencer Turbine Co., 486 New Park Ave., Hartford 6, Conn. (p. 271)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

SEPARATORS, Air, Laboratory

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Ducon Co., The, 149 E. 2nd St., Mineola, N. Y. (p. 140)
Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 65 Chatham Rd., Summit, N. J. (p. 250)
Sturtevant Mill Co., 105 Clayton, Boston 22, Mass. (p. 288)
Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 344)

SEPARATORS, Magnetic

Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Exolon Co., The, 941 E. Niagara St., Tonawanda N. Y. (p. 142, 143)
Fernholtz Machinery Co., 8468D Melrose Pl., Los Angeles 46, Calif. (p. 148)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Frantz Co., Inc., S. G., P. O. Box 1138, Kline Ave. & Brunswick Pike, Trenton 6, N. J. (p. 152)
Harrop Ceramic Service Co., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 169-172)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

SEPARATORS, Oil

W. N. Best Combustion Equip. Co., 415 11th St., Carlsbad, N. J. (p. 90)
Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)

Carborundum Co., Niagara Falls, N. Y. (p. 103-108, 110, 111)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

SETTERS, Ware

Ceramic Supply Co., Div. Ferro Corp., Box 151, Crooksville, Ohio (p. 67)
Louthan Mfg. Co., Box 781, East Liverpool, Ohio (p. 194-196)
New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
Potters Supply Co., 11 Washington St., P. O. Box 746, East Liverpool, Ohio (p. 249)
Shenango Refractories Div. of Shenango China, Inc., P. O. Box 120, New Castle, Pa. (p. 268)

SETTING MACHINES, Brick

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Steele & Sons, Inc., J. C., Mulberry St., Stateville, N. C. (p. 284-287)

SEWER PIPE DE-AIRING EQUIPMENT

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Steele & Sons, Inc., J. C., Mulberry St., Stateville, N. C. (p. 284-287)
Stevenson Co., Wellsville, Ohio (p. 289-294)
Toronto Foundry & Machine Co., Trenton St., Toronto, Ohio (p. 306)

SEWER PIPE PRESS, Auger Extrusion

Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Steele & Sons, Inc., J. C., Mulberry St., Stateville, N. C. (p. 284-287)
Toronto Foundry & Machine Co., Trenton St., Toronto, Ohio (p. 306)

SHAFTING Steel

Continental Gin Co., 4500 5th Ave. So., Birmingham 2, Ala. (p. 122)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)
Jeffrey Manufacturing Co., 913 N. Fourth St., Columbus 16, Ohio
Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

SHAKERS, Car

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 14, Wis.
Cleveland Vibrator Co., 2828 Clinton Ave., Cleveland 13, Ohio
Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.
Stephens-Adamson Mfg. Co., 35 Ridgeway Ave., Aurora, Ill.

SHAKERS, Sieve

Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Syntron Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
Tyler Co., W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

SHALE PLANERS

Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Eagle Iron Works, 127 E. Holcomb, Des Moines 13, Iowa

SHEAVES

Chambers Bros. Co., 52nd & Media St., Philadelphia 31, Pa. (p. 112, 113)
Continental Gin Co., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Miller Equip. Co., Inc., P. O. Box 1566, Salisbury, N. C. (p. 214)
Posey Iron Works, Brick Mch. & Mixer Div., Lancaster, Pa. (p. 248)
Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)

SHEET METAL BUILDING PRODUCTS

Kaiser Aluminum & Chem. Co., Building Products Dept., 919 N. Michigan Ave., Chicago 11, Ill.
Southern Fabricating, Inc., Box 97, Staley, N. C.
Swiss Fabricating, Inc., Camp Horne Rd., Emsworth, Pittsburgh 2, Pa.
R. G. Varner Steel Products, Inc., P. O. Box 781, Pine Bluff, Ark.

SHEET METAL WORK

Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
Sturtevant Mill Co., 6 Harrison Sq., Dorchester, Boston 22, Mass. (p. 288)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

SHEET, Nickel and Nickel Alloys

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

SHEETS, Steel

(See Iron, Enameling)

SHELLAC

Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)

SHELVING, Steel

Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)
Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia 20, Pa.

SHIPPING PROTECTION, Product

Hinde & Dauch Paper Co., 440 Water St., Sandusky, Ohio
Loroco Industries, Inc., 100 E. Benson, Cincinnati 15, Ohio
Mead Board Sales, Inc., 3351 Madison Rd., Cincinnati 9, Ohio
Packaging Materials Corp., 104 E. 40th St., New York, N. Y.

SHOVELS, Material Unloading

Jeffrey Manufacturing Co., 913 N. Fourth St., Columbus 16, Ohio
Link-Belt Speeder Corp., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.
Koehring Co., 3026 W. Concordia Ave., Milwaukee 16, Wis.

CLASSIFIED DIRECTORY OF SUPPLIERS

SHOVELS, Power

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Clark Equipment Co., Cons. Mach. Div., 480 Second St., Benton Harbor, Mich.
Koehring Co., 3026 W. Concordia Ave., Milwaukee 16, Wis.
Link-Belt Speeder Corp., Dept CDBL-58, Prudential Plaza, Chicago 1, Ill.
Thew Shovel Co., The, E. 28th St. & Fulton Rd., Lorain, Ohio

SHOVELS, Tractor

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Allis-Chalmers Mfg. Co., Tractor Division, 1126 S. 70th St., Milwaukee 14, Wis.
Caterpillar Tractor Co., Peoria, Ill.
Clark Equipment Co., 69 Capitol Ave., S.W., Battle Creek 4, Mich.
Hough Co., The Frank G, 753 Sunnyside Ave., Libertyville, Ill.

SHREDDERS, Clay

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
American Pulverizer Co., 1269 Macklind Ave., St. Louis 10, Mo. (p. 73)
Chambers Bros. Co., 52nd & Media Sts., Philadelphia 31, Pa. (p. 112, 113)
Fate-Root-Heath Co., Plymouth, Ohio (p. 146, 147)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Steele & Sons, Inc., J. C., Mulberry St., Statesville, N. C. (p. 284-287)
Williams Patent Crusher & Pulverizer Co., 2790 N. Broadway, St. Louis 6, Mo. (p. 321)

SIENNA

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

SIEVES, Testing

Chicago, Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Syntron Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
W. S. Tyler Co., 3615 Superior St., Cleveland, Ohio (p. 307)

SIFTERS, Industrial

Abbe Engineering Co., 50 Church St., New York 7, N. Y. (p. 70, 71)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Posey Iron Works, Inc., Brick Mach. & Mixer Div., Lancaster, Pa. (p. 248)
Tyler Co., W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
Universal Vibrating Screen Co., 1745 Deane Blvd., Racine, Wis. (p. 312)

SILENT CHAIN DRIVES

(See Drives, Chain)

SILEX BLOCKS AND LININGS

(See Mills, Balls and Linings for)

SILICA

Cabot, Inc., Godfrey L., White Pigments Div., 77 Franklin St., Boston 10, Mass. (p. 101, 102)

Ceramic Color & Chem. Mfg. Co., New Brighton, Pa. (p. 100)
Consolidated Feldspar Dept. of International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
Continental Silica Co., Box 124, Somoauk, Ill. (p. 122)
Eagle-Picher Co., American Bldg., Cincinnati, Ohio (p. 141)
Exolon Co., 941 E. Niagara St., Tonawanda, N. Y. (p. 142, 143)
Foote Mineral Co., 436 Eighteen W. Chelton Bldg., Philadelphia 44, Pa. (p. 151)
Harshaw Chemical Co., 1945 E. 97th, Cleveland 6, Ohio (p. 165)
Hommel Co., O., 209 Fourth Ave., Pittsburgh 30, Pa. (p. 178)
Johns-Manville, 22 E. 40th St., New York 16, N. Y. (p. 184, 185)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)
Pennsylvania Glass Sand Corp. of Oklahoma, 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
Pennsylvania Glass Sand Corp., 2 Gateway Center, Pittsburgh, Pa. (p. 241)
Pennsylvania Pulverizing Co., 2 Gateway Center, Pittsburgh, Pa. (p. 241)
Shenandoah Silica Co., New York Ave., Trenton, N. J. (p. 267)
Tavern Rock Sand Co., 2 Gateway Center, Pittsburgh 22, Pa. (p. 241)
Tennant, C. Sons & Co., of N. Y., 100 Park Ave., New York 17, N. Y. (p. 234, 235)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

SILICA BRICK

(See Refractories, Silica)

SILICATE OF SODA

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
International Minerals & Chem. Corp., Old Orchard Rd., Skokie, Ill. (p. 118)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)

SILICON CARBIDE

(See Refractories, Silicon Carbide)

SILICONE COMPOUNDS

Cowles Chemical Co., 7016 Euclid Ave., Cleveland 3, Ohio
Dow Corning Corp., Midland, Mich.
General Electric Co., Silicone Products Dept., Waterford, N. Y.
K & K Laboratories, 2946 Northern Blvd., Long Island City 1, N. Y.
Union-Carbide Corp., Silicones Div., 30 E. 42nd St., New York 17, N. Y.

SILICOSIS PREVENTIVE EQUIPMENT

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
American Blower Div. of American Standard, 8111 Tireman Rd., Detroit 4, Mich.
Buffalo Forge Co., 128 Mortimer St., Buffalo 4, N. Y.

SILK SCREENS

(See Screens, Silk)

SILLIMANITE

Remmy Son Co., Richard C., Hedley St. & Delaware River, Philadelphia 37, Pa. (p. 252-255)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
General Refractories Co., 1520 Locust St., Philadelphia 3, Pa.
Porter, H. K. Co., Inc., Refractories Div., Mullite Works, Shelton, Conn.

SILVER, Burnish

Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Hanovia Chemical & Mfg. Co., 1 W. Central Ave., East Newark, N. J.

SILVER CARBONATE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

SILVER COATINGS

Drakenfeld & Co., B. F., Inc., 45 Park Place, New York 7, N. Y. (p. 137)
Hanovia Liquid Gold Div., 1 W. Central Ave., East Newark, N. J.

SILVER, Decorating

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

SILVER NITRATE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

SINTERING MACHINE EQUIPMENT

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Steele & Sons, Inc., J. C., P. O. Box 951, Statesville, N. C. (p. 284-287)
Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.
Dwight-Lloyd Div., McDowell Co., Inc., 16300 Waterloo Rd., Cleveland 16, Ohio
Harper Electric Furnace Corp., 34 River St., Buffalo 2, N. Y.
National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland 6, Ohio

SINTERING MACHINES

Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Posey Iron Works, Inc., Lancaster, Pa. (p. 248)
Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.
Besser Co., Alpena, Mich.
Dravo Corp., Fifth & Liberty Ave., Pittsburgh 22, Pa.
Dwight-Lloyd Div., McDowell Co., Inc., 16300 Waterloo Rd., Cleveland 16, Ohio

SKIDS

International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
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General Glass Equipment Co., 5 S. Virginia Ave., Atlantic City, N. J.
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Baker & Co., Inc., H., 101 Duane St., New York 7, N. Y.
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United States Steel Corp., 525 William Penn Pl., Pittsburgh 30, Pa.

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STEEL GRIT AND SHOT

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STOKERS

Babcock & Wilcox Co., The, 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Laclede Stoker Co., 411 N. 7th St., St. Louis 1, Mo.
U. S. Machine Corp., Lebanon, Ind.

STORAGE SYSTEMS

Bonnot Co., The, 721 Mulberry Rd., S.E., Canton 2, Ohio (p. 94)
Continental Gin Co., 4500 5th Ave. So., Birmingham 2, Ala. (p. 119)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
Posey Iron Works, Inc., Lancaster, Pa. (p. 248)
Stevenson Co., Wellsville 1, Ohio (p. 289-294)
Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)

STOVE ROOMS

(See Mangles)

STRAIN TESTING

North American Phillips Co., 100 E. 42nd St., New York 17, N. Y.

STRAINERS, Misc.

Tyler Co., W. S., 3615 Superior Ave., Cleveland 14, Ohio (p. 307)
Anthony Co., The, 47-35 Fifth St., Long Island City 1, N. Y.

STRAINERS, Oil

Best, W. N., Combustion Equip. Co., 415 11th St., Carlstadt, N. J. (p. 90)
Hauck Mfg. Co., 133-143 Tenth St., Brooklyn 15, N. Y. (p. 168)
Anthony Co., The, 47-35 Fifth St., Long Island City 1, N. Y.
National Airoil Burner Co., 1240 E. Sedgley, Philadelphia 34, Pa.
Schurs Oil Burner Co., 8500 Zamore Ave., Los Angeles 1, Calif.

STRAPPING, Steel

Acme Steel Co., 2840 S. Archer, Chicago 8, Ill.
Gerrard Steel Strapping Div., U. S. Steel Corp., 2915 W. 47th St., Chicago 32, Ill.
Signode Steel Strapping Co., 2600 N. Western Ave., Chicago 47, Ill.
Stanley Works, New Britain, Conn.

STRONTIUM CARBONATE

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Foote Mineral Co., 436 Eighteen W. Cheltenham Bldg., Philadelphia 44, Pa. (p. 151)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Barium Reduction Corp., South Charleston, W. Va.

SULFUR

Ceramic Color & Chem. Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
McGean Chemical Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
Stauffer Chemical Co., 380 Madison Ave., New York 17, N. Y. (p. 272)
Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)
Faesy & Besthoff, Inc., 25 East 26th St., New York 10, N. Y.
General Chem. Div., Allied Chem. & Dye Corp., 40 Rector St., New York 6, N. Y.
Sculpture House, 304 W. 42nd St., New York 36, N. Y.

SULFURIC ACID

(See Acids)

SUPER REFRACTORY BRICK

Babcock & Wilcox Co., The, 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Carborundum Co., Niagara Falls, N. Y. (p. 103-108, 110, 111)
Electro Refr. Abr. Corp., 344 Delaware Ave., Buffalo 2, N. Y. (p. 144)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Harbison-Walker Refr. Co., 307 5th Ave., Pittsburgh 22, Pa. (p. 162, 163)
Johns-Manville, 22 E. 40th St., New York 16, N. Y. (p. 184, 185)
Miller Equip. Co., P. O. Box 1566, Salisbury, N. Carolina (p. 214)
New Castle Refractories Co., S. Swansea Ave., New Castle, Pa. (p. 218-221)
Norton Co., 1 New Bond, Worcester 6, Mass. (p. 225-230)
Remmey Son Co., Richard C., Hedley St., & Delaware Riv., Philadelphia 37, Pa. (p. 252-255)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)

CLASSIFIED DIRECTORY OF SUPPLIERS

Titanium Alloy Mfg. Div., National Lead Co., Hyde Park Blvd. & Lafayette Ave., Niagara Falls, N. Y. (p. 299-302)
Wellsville Fire Brick Co., Wellsville 8, Mo. (p. 318)
Zirconium Corp. of America, P. O. Box 196, Solon, Ohio (p. 325)

SUSPENDED FURNACE ENCLOSURE

Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Taylor Sons Co., Chas., P. O. Box 58, Annex Stn., Cincinnati 14, Ohio (p. 297)
Laclede-Christy Co., Div. of H. K. Porter Co., Inc., 2000 Hampton Ave., St. Louis 10, Mo.
Mexico Refractories Co., Coal & Love Sts., Mexico, Mo.

SWABBING COMPOUND, Glass Mold

Specialty Products Co., 190 Warren St., Jersey City 2, N. J.
Vanderbilt Co., R. T., 230 Park Ave., New York 17, N. Y.

SWITCHBOARDS

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 14, Wis.
General Electric Co., 1 River Rd., Schenectady 5, N. Y.
Westinghouse Electric Co., E. Pittsburgh, Pa.

SWITCHGEAR

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 14, Wis.
General Electric Co., 1 River Rd., Schenectady 5, N. Y.
Westinghouse Electric Co., E. Pittsburgh, Pa.

TABLES, Brushing and Rimming

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
DeVilbiss Co., The, 300 Phillips, Toledo 1, Ohio
Kirk & Blum Mfg. Co., 3165 Forrer St., Cincinnati 9, Ohio
Ohio Blow Pipe Co., 1725 Doan Ave., Cleveland 12, Ohio

TABLES, Concentrating

Deister Concentrator Co., 933 Glasgow Ave., Fort Wayne 4, Ind. (p. 138, 139)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa. (p. 283)

TABLETTEING MACHINES

Denison Engineering Co., 1160 Dublin Rd., Columbus 16, Ohio (p. 123)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa. (p. 283)

TACHOMETERS

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
Barber-Colman Co., Wheelco Instruments Div., 1300 Rock St., Rockford, Ill.
General Electric Co., 1 River Road, Schenectady 5, N. Y.

TALC

Ceramic Color & Chemical Mfg. Co., New Brighton, Pa. (p. 100)
Harshaw Chemical Co., 1945 E. 97th St., Cleveland 8, Ohio (p. 165)

Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
International Talc Co., Inc., 90 West St., New York 6, N. Y. (p. 181)
Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)
United Clay Mines Corp., 101 Oakland St., Trenton 8, N. J.

TALLOW

Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Specialty Products Co., 190 Warren St., Jersey City 2, N. J.

TALLOW OILS

Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Specialty Products Co., 190 Warren St., Jersey City 2, N. J.

TANK BLOCKS

Babcock & Wilcox Co., The, 161 E. 42nd St., New York 17, N. Y. (p. 81-84)
Carborundum Co., Niagara Falls, N. Y. (p. 103-108, 110, 111)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
Corhart Refractories Co., 16th & Lee Sts., Louisville 10, Ky.
General Glass Equipment Co., 5 S. Virginia Ave., Atlantic City, N. J.
Laclede-Christy Co., Div. of H. K. Porter Co., Inc., 2000 Hampton Ave., St. Louis 10, Mo.

TANK BLOCK COOLING SYSTEMS

Robinson Ventilating Co., Zelenople, Pa. (p. 258, 259)
General Glass Equip. Co., Atlantic County Trust Bldg., Atlantic City, N. J.
Kirk & Blum Mfg. Co., 3165 Forrer St., Cincinnati 9, Ohio

TANKS, Air

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

TANKS, Banding Lugs

Hauser-Stander Tank Co., 4838 Spring Grove Ave., Cincinnati 32, Ohio (p. 172)
Tecktonius Mfg. Co., E. C., 1026 12th St., Racine, Wis.

TANKS, Enamel Agitator

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Fernholtz Mach. Co., 8468 Melrose Pl., Los Angeles 46, Calif. (p. 148)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Hauser-Stander Tank Co., 4838 Spring Grove Ave., Cincinnati 32, Ohio (p. 173)
Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Patterson, Fdy. & Mach. Co., 1250 St. George St., Liverpool, Ohio (p. 246, 247)
Stevenson Co., The, Wellsville, Ohio (p. 289-294)

TANKS, Glass, Continuous and Day

Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio (p. 295)
Taylor Sons Co., Chas., 706 Burns St., Cincinnati 4, Ohio (p. 297)
Frazier-Simplex, Inc., 436 E. Beau St., Washington, Pa.
General Glass Equipment Co., 5 S. Virginia Ave., Atlantic City, N. J.
Laclede-Christy Co., Div. of H. K. Porter Co., 2000 Hampton Ave., St. Louis 10, Mo.
Porter Co., Inc., H. K., Refractories Div., Mullite Works, Shelton, Conn.

TANKS, Lead-Lined

(See Tanks, Pickling)

TANKS, Pickling

Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
Hauser-Stander Tank Co., 4838 Spring Grove Ave., Cincinnati 32, Ohio (p. 173)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
U. S. Stoneware Co., 12 East Ave., Tallmadge, Ohio (p. 311)

TANKS, Rubber Lined

Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
Hauser-Stander Tank Co., 4838 Spring Grove Ave., Cincinnati 32, Ohio (p. 173)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Patterson Fdy. & Mach. Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Stevenson Co., Wellsville 1, Ohio (p. 289-294)
U. S. Stoneware Co., 12 East Ave., Tallmadge, Ohio (p. 311)

TANKS, Spray

Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill. (p. 91)
Ceramic Color & Chemical Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
Patterson Fdy. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246, 247)
Pemco Corp., 5601 Eastern Ave., Baltimore 24, Md. (p. 236)

TANKS, Steel

Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)
Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
Fiedler, C. O., Inc., 2221 E. 37th St., Los Angeles 58, Calif. (p. 150)
Hauser-Stander Tank Co., 4822 Spring Grove Ave., Cincinnati 32, Ohio (p. 173)
Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Miller Equipment Co., P. O. Box 1566, Salisbury, N. C. (p. 214)
Patterson Fdy. & Machine Co., 1250 St. George St., East Liverpool, Ohio (p. 246)
Patterson-Kelly Co., Inc., 500 Warren St., East Stroudsburg, Pa. (p. 237-240)
Posey Iron Works, Inc., Brick Mch. & Mixer Div., Lancaster, Pa. (p. 248)
Stevenson Co., Wellsville 1, Ohio (p. 289-294)

TANKS, Wood

Chicago Vitreous Corp., 1425 S. 55th Crt., Cicero 50, Ill. (p. 114)

CLASSIFIED DIRECTORY OF SUPPLIERS

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio (p. 65-68, 149)
 Hauser-Stander Tank Co., 4838 Spring Grove Ave., Cincinnati 32, Ohio (p. 173)
 Stevenson Co., Wellsville 1, Ohio (p. 289-294)

TANTALUM, Compounds of

Foote Mineral Co., Rm. 436, 18 W. Chelton Bldg., Philadelphia 44, Pa. (p. 151)
 Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
 Shieldalloy Corp., Newfield, N. J.

TESTER, Impact

National Forge & Ordnance Co., Testing Mach. Div., Irvine, Warren County, Pa.

TESTING, Clay

(See Engineering Service, Heavy Clay)

TESTING DEVICES, Glass

Hartford-Empire Co., Div. of Emhart Mfg. Co., 333 Homestead Ave., Hartford 2, Conn.
 Toledo Engineering Co., 958 Wall St., Toledo 10, Ohio

TESTING PRESSES, Hydraulic

Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J. (p. 120, 121)
 Denison Engineering Div. of American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, Ohio (p. 123)
 Loomis Eng. & Mfg. Co., Dept. CD, Route 46 near Clinton Rd., Caldwell, N. J. (p. 198)
 Owen & Son, N. B., 4819 Emerald St., Torrance, Calif.
 Hydraulic Press Mfg. Co., Mt. Gilead, Ohio

TESTS, Non-Destructive, Metals and Non-Metals

North American Phillips Co., 100 E. 42nd St., New York 17, N. Y.

TETRA SODIUM PYROPHOSPHATE

(See Phosphates)

THAWING EQUIPMENT

Hauck Mfg. Co., 133-143 Tenth St., Brooklyn 15, N. Y. (p. 168)
 General Electric Co., 1 River Road, Schenectady 5, N. Y.

THERMOCOUPLES

Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, Ohio (p. 85)
 Harrop Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio (p. 169-172)
 Miller Equip. Co., Inc., P. O. Box 1566, Salisbury, N. C. (p. 214)
 Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Pereny Equipment Co., 893 Chambers Rd., Box 153, Stn. A, Columbus 12, Ohio (p. 244, 245)
 Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

THERMOMETERS

Miller Equip. Co., Inc., P. O. Box 1566, Salisbury, N. C. (p. 214)
 Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Barber-Colman Co., Wheelco Instruments Div., 1300 Rock St., Rockford, Ill.
 General Electric Co., 1 River Road, Schenectady 5, N. Y.
 Brinkmann Instruments, Inc., 115 Cutter Rd., Great Neck, N. Y.
 Schurs Oil Burner Co., 8500 Zamore Ave., Los Angeles 1, Calif.

THERMOSTATS

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (p. 212, 213)
 Barber-Colman Co., Wheelco Instruments Div., 1300 Rock St., Rockford, Ill.
 General Electric Co., 1 River Road, Schenectady 5, N. Y.
 Schurs Oil Burner Co., 8500 Zamore Ave., Los Angeles 1, Calif.

THICKENERS

Hardinge Co., Inc., 240 Arch St., York, Pa. (p. 164)
 Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
 Stevenson Co., Wellsville 1, Ohio (p. 289-294)
 Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

THIMBLES

Louthan Mfg. Co., Subsidiary of Ferro Corp., 2000 Harvey Ave., East Liverpool Ohio (p. 194-196)
 Norton Co., 1 New Bond St., Worcester 6, Mass. (p. 225-230)
 Potters Supply Co., 11 Washington, East Liverpool, Ohio (p. 249)
 Industrial Ceramic Products, Inc., 965 W. 5th Ave., Columbus 8, Ohio

TIERING MACHINES

(See Stackers)

TIGHTENERS, Belt

Continental Gin Co., 4500 5th Ave., So., Birmingham 2, Ala. (p. 119)
 Jeffrey Manufacturing Co., 913 N. Fourth St., Columbus 16, Ohio
 Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.
 Pioneer Engineering Works, Inc., 1515 Central Ave., Minneapolis 13, Minn.

TIN OXIDE

Ceramic Color & Chemical Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
 Metal & Thermit Corp., Rahway, N. J. (p. 210, 211)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)
 Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)

TIRES, Industrial Cars, Trucks and Wheelbarrow

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
 Posey Iron Works, Inc., Lancaster, Pa. (p. 248)
 Toronto Foundry & Machine Co., Trenton St., Toronto, Ohio (p. 306)
 Gates Rubber Co., Sales Div., Inc., 999 S. Broadway, Denver 17, Colo.
 Goodrich Co., B. F., 500 S. Main St., Akron 11, Ohio
 Goodyear Tire & Rubber Co., 1141 E. Market, Akron 5, Ohio

TITANATES

Ceramic Color & Chemical Mfg. Co., New Brighton, Pa. (p. 100)
 Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Titanium Alloy Mfg. Div., National Lead Co., 111 Broadway, New York 6, N. Y. (p. 299-302)

TITANIUM OXIDE

Ceramic Color & Chemical Mfg. Co., P. O. Box 81, New Brighton, Pa. (p. 100)
 Drakenfeld & Co., B. F., 45-47 Park Pl., New York 7, N. Y. (p. 137)

Foote Mineral Co., Rm. 436, 18 W. Chelton Bldg., Philadelphia 44, Pa. (p. 151)
 Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio (p. 165)
 Hommel Co., O., P. O. Box 457, Pittsburgh 30, Pa. (p. 178)
 Kraft Chemical Co., 917 W. 18th St., Chicago 8, Ill. (p. 190)
 McGean Chem. Co., 1040 Midland Bldg., Cleveland 15, Ohio (p. 199)
 National Lead Co., Titanium Alloy Mfg. Div., 111 Broadway, New York 6, N. Y. (p. 299-302)
 Samuel & Co., Frank, 2200 Philadelphia Nat'l Bk. Bldg., Philadelphia 7, Pa. (p. 264)
 Titanium Alloy Mfg. Co., Div. National Lead Co., 111 Broadway, New York 6, N. Y. (p. 299-302)
 Titanium Pigment Corp., Subsidiary of National Lead Co., 111 Broadway, New York 6, N. Y. (p. 304, 305)
 Vitro Mfg. Co., 60 Greenway Dr., Pittsburgh 4, Pa. (p. 89)
 Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y. (p. 320)

TOOLS, Carbide Tipped

Miller Pottery Engineering Co., 2300 Palmer St., Swissvale, Pittsburgh 18, Pa. (p. 216)
 General Electric Co., 11177 E. Eight Mile Rd., Detroit 32, Mich.
 Milligan Hardware & Supply Co., The, 115-117 E. 5th St., East Liverpool, Ohio
 Ton-Tex Corp., 247 Pearl St., N.W., Grand Rapids 2, Mich.

TOOLS, Electric Portable

Syntron Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
 Ton-Tex Corp., 247 Pearl St., N.W., Grand Rapids 2, Mich.

TOOLS, Fetting

Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)
 Milligan Hardware & Supply Co., The, 115-117 E. 5th St., East Liverpool, Ohio
 Sculpture House, 304 W. 42nd St., New York 36, N. Y.

TOOLS, Modeling

Hommel Co., O., 209 Fourth Ave., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
 Milligan Hardware & Supply Co., The, 115-117 E. 5th St., East Liverpool, Ohio
 Sculpture House, 304 W. 42nd St., New York 36, N. Y.

TOOLS, Portable, Air and Electric

Syntron Co., 750 Lexington Ave., Homer City, Pa. (p. 296)
 Worthington Corp., Holyoke, Mass. (p. 324)
 Ton-Tex Corp., 247 Pearl St., N.W., Grand Rapids 2, Mich.

TOOLS, Turning

General Electric Co., 11177 E. Eight Mile Rd., Detroit 32, Mich.
 Milligan Hardware & Supply Co., The, 115-117 E. 5th St., East Liverpool, Ohio
 Sculpture House, 304 W. 42nd St., New York 36, N. Y.

TORCHES, Oil Blow

Hauck Mfg., 133-143 Tenth St., Brooklyn 15, N. Y. (p. 168)
 Anthony Co., 47-35 Fifth St., Long Island City 1, N. Y.
 National Airoil Burner Co., 1240 E. Sedgley, Philadelphia 34, Pa.

TOTE BOXES

(See Boxes, Tote)

TRACTOR SCRAPERS

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)

CLASSIFIED DIRECTORY OF SUPPLIERS

Allis-Chalmers Mfg. Co., Tractor Div., 1126 S. 70th St., Milwaukee 14, Wis.
Caterpillar Tractor Co., Peoria 8, Ill.

TRACTOR SHOVELS

(See Shovels, Tractor)

TRACTORS

American Clay Machinery Div. of Huber-Warco Co., Bucyrus, Ohio and Marion, Ohio (p. 76, 77)
Fate-Root-Heath Co., 406 Riggs Ave., Plymouth, Ohio (p. 146, 147)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Allis-Chalmers Mfg. Co., Tractor Div., 1126 S. 70th St., Milwaukee 14, Wis.
Caterpillar Tractor Co., 600 W. Washington, Peoria 8, Ill.
Gravely Tractors, P. O. Box 465, Dunbar, W. Va.
Hough Co., The, Frank G., 753 Sunnyside Ave., Libertyville, Ill.

TRACTORS, Box Car Unloading

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Allis-Chalmers Mfg. Co., Tractor Div., 1126 S. 70th St., Milwaukee 14, Wis.
Hough Co., The, Frank G., Libertyville, Ill.
Hyster Co., 2970 N.E. Clackamas St., Portland 13, Ore.

TRACTOR, Crawler

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Allis-Chalmers Mfg. Co., Tractor Div., 1126 S. 70th St., Milwaukee 14, Wis.
Case Co., J. I., Racine, Wis.
Caterpillar Tractor Co., Peoria, Ill.

TRACTORS, Dump

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Allis-Chalmers Mfg. Co., Tractor Div., 1126 S. 70th St., Milwaukee 14, Wis.
Clark Equipment Co., 69 Capitol Ave., Battle Creek 4, Mich.

TRACTORS, Industrial (Power)

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Allis-Chalmers Mfg. Co., Tractor Div., 1126 S. 70th St., Milwaukee 14, Wis.
Caterpillar Tractor Co., 600 W. Washington, Peoria 8, Ill.
Clark Equipment Co., 69 Capitol Ave., Battle Creek 4, Mich.
Hyster Co., 2970 N.E. Clackamas St., Portland 12, Ore.

TRACTORS, Towing

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Allis-Chalmers Mfg. Co., Tractor Div., 1126 S. 70th St., Milwaukee 14, Wis.
Clark Equipment Co., 69 Capitol Ave., Battle Creek 4, Mich.
Hough Co., Frank G., Libertyville, Ill.

TRACTORS, Wheel-Type

Allis-Chalmers Mfg. Co., Tractor Div., 1126 S. 70th St., Milwaukee 14, Wis.
Caterpillar Tractor Co., Peoria 8, Ill.
LeTourneau-Westinghouse Co., 2301 N. Adams, Peoria, Ill.

TRAILERS

International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Ohio Galvanizing & Mfg. Co., The, Niles, Ohio (p. 242)
American Tractor Corp., Churubusco, Ind.
Clark Equipment Co., 69 Capitol Ave., Battle Creek 4, Mich.
Yale & Towne Mfg. Co., Roosevelt Blvd., Philadelphia 15, Pa.

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LeTourneau-Westinghouse Co., 2301 N. Adams, Peoria, Ill.

TRAMWAYS, Aerial

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Richards-Wilcox Mfg. Co., 2176 Third St., Aurora, Ill. (p. 257)
Cleveland Tramrail Div., The Cleveland Crane & Engineering Co., Wickliffe, Ohio

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General Electric Co., 1 River Road, Schenectady 5, N. Y.
Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

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Worthington Corp., 401 Worthington Ave., Harrison, N. J. (p. 324)
Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.
Great Western Mfg. Co., 208-220 Choctaw St., Leavenworth, Kans.
Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

TRANSMISSION MACHINERY

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Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.

TRANSMISSION, Variable Speed

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American Blower Div. American-Standard, Detroit 32, Mich.
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Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio
Ton-Tex Corp., 247 Pearl St., N.W., Grand Rapids 2, Mich.
Westinghouse Electric Corp., East Pittsburgh, Pa.

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Aggregates Equip., Inc., E. Walnut & Plum Sts., Lancaster, Pa.
Jeffrey Manufacturing Co., 913 N. Fourth St., Columbus 16, Ohio
Link-Belt Co., Dept. CDBL-58, Prudential Plaza, Chicago 1, Ill.
Manufacturers Equipment Co., 218 Madeira Ave., Dayton 4, Ohio

TRI SODIUM PHOSPHATE

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Faesy & Besthoff, Inc., 25 E. 26th St., New York 10, N. Y.

TRUCKS, Electric Batteries for

Electric Storage Battery Co., 19th & Allegheny Ave., Philadelphia 32, Pa.
Manufacturers Equipment Co., 218 Madeira Ave., Dayton 4, Ohio
Yale & Towne Mfg. Co., 1000 Roosevelt Blvd., Philadelphia 15, Pa.

TRUCKS, Fork

Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Case Co., J. I., Racine, Wis.
Hyster Co., 2970 N.E. Clackamas, Portland 12, Ore.
Yale & Towne Mfg. Co., 1000 Roosevelt Blvd., Philadelphia 15, Pa.

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International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
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Chase Foundry & Mfg. Co., 2300 Parsons, Columbus 7, Ohio
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TRUCKS, Lift, Telescopic, Gasoline Power

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Hyster Co., 2970 N. E. Clackamas St., Portland 12, Ore.

TRUCKS, Platform

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Hyster Sales Co., 2105 S. E. 7th St., Portland 8, Ore.
Kwik-Mix Co., Port Washington, Wis.
Yale & Towne Mfg. Co., 11000 Roosevelt Blvd., Philadelphia 15, Pa.

TRUCKS, Two Wheel

Flink Co., 502 N. Vermillion St., Streator, Ill.
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General Electric Co., 1 River Rd., Schenectady 5, N. Y.
 New York Blower Co., 3155 Shields Ave., Chicago 16, Ill.

UNLOADERS, Brick and Block

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 Jeffrey Manufacturing Co., 913 N. Fourth St., Columbus 16, Ohio
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 Stephens-Adamson Mfg. Co., Ridgeway Ave., Aurora, Ill.

VALVES, 4-Way

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VALVES, General

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 Jeffrey Manufacturing Co., 913 N. Fourth St., Columbus 16, Ohio

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 Schurs Oil Burner Co., 8500 Zamore Ave., Los Angeles 1, Calif.

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 Maxon Premix Burner Co., P. O. Box 71, Muncie, Ind.
 Schurs Oil Burner Co., 8500 Zamore Ave., Los Angeles 1, Calif.

VALVES, Reducing

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 North American Mfg. Co., 4455 E. 71st St., Cleveland 5, Ohio
 Schurs Oil Burner Co., 8500 Zamore Ave., Los Angeles 1, Calif.
 Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio

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VALVES, Reversing

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VALVES, Safety

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 Eclipse Fuel Eng. Co., 1027 Buchanan St., Rockford, Ill.
 Maxon Premix Burner Co., P. O. Box 71, Muncie, Ind.
 North American Mfg. Co., 4455 E. 71st St., Cleveland 5, Ohio
 Schurs Oil Burner Co., 8500 Zamore Ave., Los Angeles 1, Calif.

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 Manufacturers Equipment Co., 218 Madeira Ave., Dayton 4, Ohio
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WATER COOLING DEVICES

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WATER SEALS, Gas Producer

(See also Gas Producers)

Frazier-Simplex, Inc., 428 E. Beau St., Washington, Pa.
Wellman Engineering Co., 7036 Central Ave., Cleveland 4, Ohio

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Westvaco Chlor-Alkali Div., Food Machy. & Chem. Corp., 161 E. 42nd St., New York 17, N. Y. (p. 319)
Worthington Corp., Harrison, N. J. (p. 324)
Illinois Water Treatment Co., 840 Cedar St., Rockford, Ill.
Olin Mathieson Chem. Corp., Industrial Chem Div. Baltimore 10, Md.

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Hommel Co., O., P. O. Box 475, Pittsburgh 30, Pa. (p. 178)
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(See Alloys, Wear Resisting)

WEIGHERS, Conveyor

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Hardinge Co., Inc., 240 Arch, York, Pa. (p. 164)
Lawler Co., Durham Ave. & L.V.R.R., Metuchen, N. J. (p. 192)
Schaffer Poidometer Co., 2525 Smallman St., Pittsburgh 22, Pa. (p. 265)
Syntrol Co., 750 Lexington, Homer City, Pa. (p. 296)

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(See also Electrodes, Hard Facing, Welding)

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Metal & Thermit Corp., Rahway, N. J. (p. 210, 211)
Alloy Rods Co., York, Pa.
American Manganese Steel Div., 389 E. 14th, Chicago Heights, Ill.
General Electric Co., 1 River Road, Schenectady 5, N. Y.
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

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Metal & Thermit Corp., Rahway, N. J. (p. 210, 211)

See Their Catalogs for Complete Buying Information

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., 361 Delaware Ave., Buffalo 2, N. Y. (p. 322, 323)
Worthington Corp., Plainfield, N. J. (p. 324)

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(See also Electrolytes)

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Wahl, Inc., A. J., 8 Central Ave., Brocton, N. Y. (p. 317)
Chase Foundry & Mfg. Co., 2300 Parsons, Columbus 7, Ohio
Manufacturers Equipment Co., 218 Madeira Ave., Dayton 4, Ohio

WHEELS, Diamond

Carborundum Co., The, Niagara Falls, N. Y. (p. 103-108, 110, 111)
Norton Co., 1 New Bond, Worcester 6, Mass. (p. 225-230)
General Electric Co., 11177 E. Eight Mile Rd., Detroit 32, Mich.

WHEELS, Hand Truck

Ohio Galvanizing & Mfg. Co., Ann & Price Sts., Niles, Ohio (p. 242)
American Brake Shoe Co., 230 Park Ave., New York 17, N. Y.
Chase Foundry & Mfg. Co., 2300 S. Parsons Ave., Columbus 7, Ohio

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International Clay Machinery Co., 1145 Bolander Ave., Dayton 1, Ohio (p. 182, 183)
Miller Equip. Co. Inc., P. O. Box 1566, Salisbury, N. C. (p. 214)
Chase Foundry & Mfg. Co., 2300 Parsons, Columbus 7, Ohio
Sanford-Day Iron Works, Knoxville 9, Tenn.

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International Clay Machinery Co., 1145 Bolander, P. O. Box 973, Dayton 1, Ohio (p. 182, 183)
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Felker Mfg. Co., 1128 Border Ave., Torrance, Calif.

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ZIRCON REFRACTORIES

(See Refractories, Zircon)

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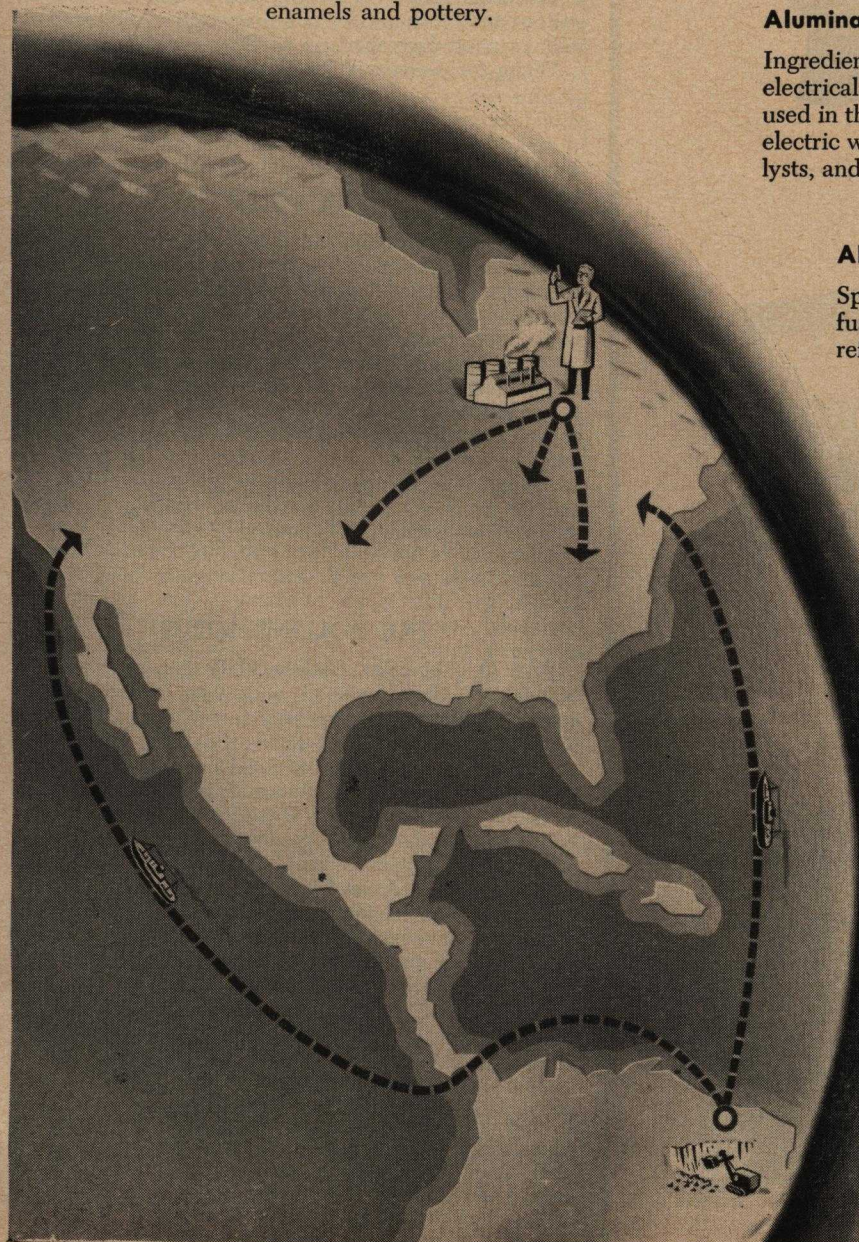
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Calcined bauxite used primarily for the manufacture of artificial aluminous abrasives.

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High-grade super-calcined bauxite for the manufacture of super-refractories such as high-alumina firebrick and mullite.



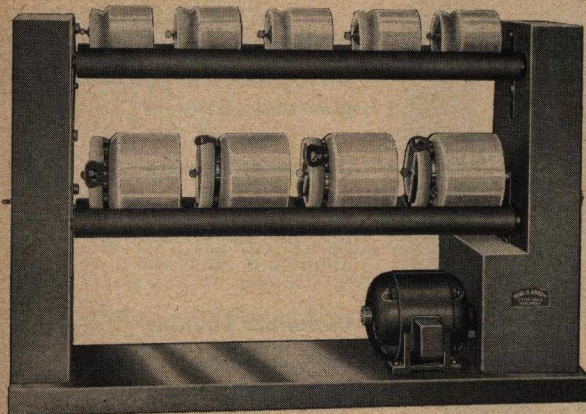
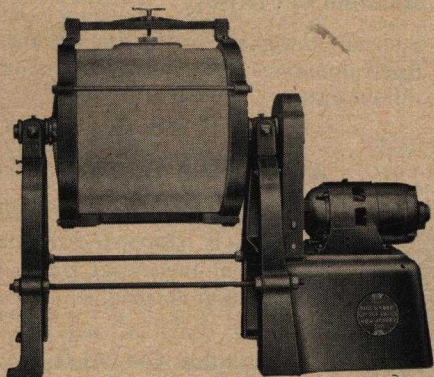
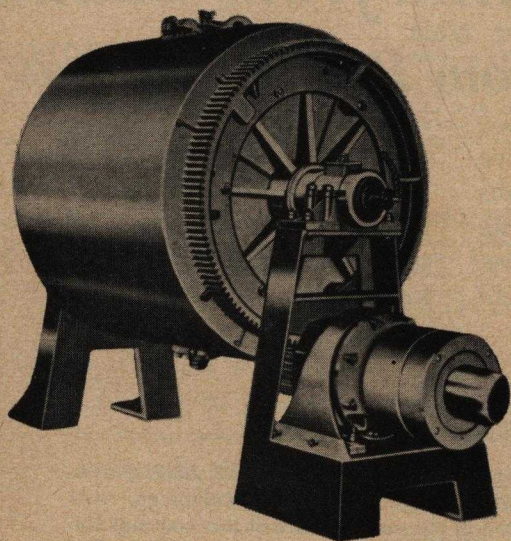
PAUL O. ABBÉ, INC.

261 Center Avenue, Little Falls, New Jersey

BALL & PEBBLE MILLS

DRY & PASTE MIXERS

ROTA-CONE BLENDERS & VACUUM DRYERS



BALL & PEBBLE MILLS

The new Paul O. Abbé Ball and Pebble Mills are the finest machines of their type ever built. They feature the "All Steel" cylinder with rugged steel ends and forged alloy steel trunnions lathe-turned cylinders for perfect alignment of bearings and gears welded steel manhole frames and steel grinding covers fine tooth machine-cut gears rugged supporting stands with working clearance under discharge highest quality babbitted or anti-friction roller bearings wide selection of drive arrangements finest linings, including Imported Belgian Burrstone, standard and high density Porcelain in Pebble Mills, and special abrasion resistant steel shells in Steel Ball Mills.

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JARS

Paul O. Abbé Jars are made of highest quality white vitrified porcelain. They can also be made of steel, iron, bronze and stainless steel with rubber linings, or constructed of other materials.

Write for Section A of Catalog "Y".

PAUL O. ABBÉ, INC.

261 Center Avenue, Little Falls, New Jersey

PAUL O. ABBÉ

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RIBBON MIXERS

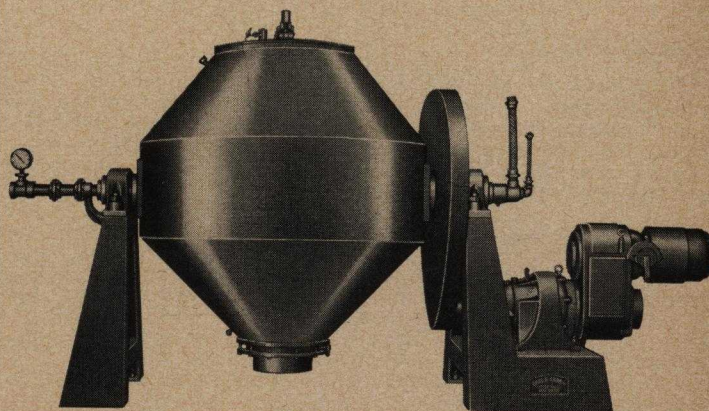
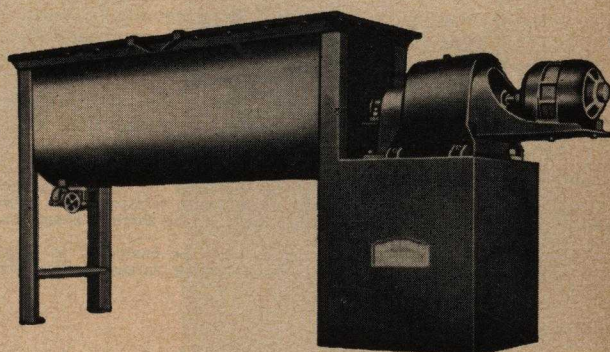
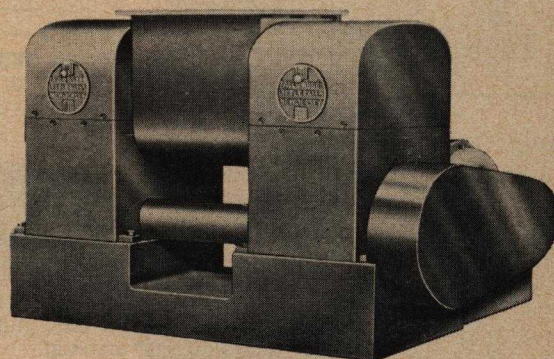
Paul O. Abbé Ribbon Mixers are widely used throughout the ceramic industry for thorough mixing and blending of abrasive powders, clay bodies, ferrites and other dry, free-flowing materials, as well as for liquids or slurries. The various ingredients to be mixed are merely dumped into the mixing chamber, where accurately engineered spiral blades completely blend and mix them. An ounce or less of one material can be mixed with pounds or hundred-weights of another material in a very short time. Discharging is quickly and easily accomplished through a valve located in the bottom of the mixing bowl. Styles of mixing blades, styles and location of loading openings and discharge valve, materials of construction and drive arrangements can be varied to provide the mixer best suited to the particular application involved. Bowls can be jacketed for temperature control. These mixers are offered in sizes from 0.1 cu. ft. to 186 cu. ft. mixing capacities. Write for Catalog "V-1".

ROTA-CONE BLENDERS

Paul O. Abbé Rota-Cone Blenders are used extensively for quick and thorough mixing of all kinds of dry, free-flowing materials. They are also used for introducing small amounts of liquid into dry batches through a special atomizing spray pipe. Internal beating elements can be provided where materials tend to aggregate or form soft lumps or balls. Made in a complete range of sizes from 0.1 cu. ft. to 325 cu. ft. mixing volume, they can be furnished in mild steel, stainless steel, aluminum, Monel and bronze, and may be lined with rubber or plastic if desired. Write for the Rota-Cone folder "C".

ROTA-CONE VACUUM DRYERS

A most economical and efficient means for batch drying a wide variety of products, the Rota-Cone Vacuum Dryer assures uniform drying throughout the entire batch of material. In operation, a hot fluid is circulated through the insulated jacket while the Dryer rotates continuously and the internal atmosphere is evacuated. The extremely gentle blending-drying action of the Rota-Cone does not abrade or reduce particles. The process is completely dustless and the Dryer may be easily cleaned between batches. Available in a complete range of sizes from 0.1 cu. ft. to 325 cu. ft. mixing volume, they are made of steel, stainless steel, aluminum, Monel or bronze. Write for Rota-Cone folder "C".



AMERICAN NEPHELINE, LIMITED

PLANT: NEPHTON, ONT.

SALES OFFICE: 25 KING ST. W. TORONTO, ONT.



Producers of

Lakefield Nepheline Syenite

Exclusive U. S. Sales Agents
GREAT LAKES FOUNDRY SAND CO.
DETROIT, MICH.

Sales Agents — United Kingdom and Europe
UNION OXIDE & CHEMICAL CO., LTD.
MINCING LANE, LONDON E. C. 3

ADVANTAGES

UNLIMITED
SUPPLY

—
UNIFORMITY

—
ECONOMY

—
SERVICE

General Description

"LAKEFIELD" nepheline syenite is a crystalline granular igneous rock composed of nepheline, potash feldspar, soda feldspar and a few minor accessory minerals, chiefly magnetite. It contains little or no free quartz. The mineral nepheline, $(\text{NaKO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2)$ crystallized from the molten magma because there was insufficient silica present to form soda feldspar. "Lakefield" nepheline syenite as refined from this rock is possessed of unusual natural uniformity, and the deposit contains an unlimited supply of raw material.

Chemical Analysis

SiO ₂	60.4 %	Na ₂ O	9.8
Al ₂ O ₃	23.6	K ₂ O	4.6
Fe ₂ O ₃	0.08	Ignition Loss	0.7
CaO	0.7		
MgO	0.1		99.98

Fundamental Properties

The molecular formula of "Lakefield" nepheline syenite is 0.75 Na₂O-0.25 K₂O, and 1.1 Al₂O₃ and 4.5 SiO₂; the combining wt. is 452.

It fuses several cones lower and its sintering range is several cones lower than potash feldspar. It starts to sinter at Cone 08 and has a P.C.E. of 6, or sintering range of about 13 cones.

Combinations of nepheline syenite with talc, whiting, pyrophyllite, etc., are active at lower temperatures than similar feldspar combinations.

Nepheline syenite in the crystalline form has a higher thermal expansion than the mineral potash feldspar. Glass obtained by melting nepheline syenite has a lower thermal expansion than potash feldspar glass. Differences in thermal history produce less change in the thermal expansion of nepheline syenite than in feldspars.

The greater refractoriness of American clays as compared to English clays is compensated for by the increased fluxing action of "Lakefield" nepheline syenite.

Glass

High alumina and alkali values combined with low iron content have made "Lakefield" nepheline syenite the best and most economical means for introducing aluminum oxide into the glass batch.

The continuous use of "Lakefield" nepheline syenite over a period of years has shown very conclusively that it is an unusually uniform material. In addition to its constancy it promotes a faster melting glass resulting in more production through the machines, or it is possible to lower the melting temperature. This means a saving in fuel and refractories.

Semi-Vitreous Ware

In the semi-vitreous body, nepheline syenite produces increased vitrification. There is a long firing range which results in less warpage. In bodies fluxed with nepheline syenite the thermal expansion is greater than in corresponding feldspar bodies. This tends to further a state of compression in the glaze and reduces crazing tendencies.

Sanitary Porcelain

There are many advantages to be gained from lower maturing temperatures in sanitary porcelain bodies, and nepheline syenite makes this possible. The use of nepheline syenite in reduced amounts to replace feldspar affords a long vitrification range, making possible less warpage. The mechanical strength and expansion of bodies containing nepheline syenite compare favorably with those fluxed with feldspar. Porcelains containing nepheline syenite have a steel-like ring, the pitch being higher than the ordinary body.

Low Temperature Vitreous Bodies

An outstanding development of our research staff is the new low temperature (Cone 3-5) vitreous bodies which can be formulated from clays and nepheline syenite without the use of an auxiliary flux. These new bodies have an unusually long firing range and excellent strength when prepared by wet ball milling.

The higher the nepheline syenite content of the bodies the higher the thermal expansion and the smaller the variation in expansion with differences in thermal history.

The addition of 5% to 10% flint raises the thermal expansion of the bodies so that a typical semi-vitreous dinnerware glaze is placed under adequate compression.

A new type of dinnerware made from this body is highly translucent, quite hard, and possesses the satiny texture so much admired in Belleek ware. New glazes with favorable service characteristics have been developed and it is believed that a new trend in the Ceramic Industry will be built up around this new use of syenite.

Floor and Wall Tile Bodies

The low fusibility and potent fluxing action of nepheline syenite permit the formulation of bodies maturing at lower temperatures and increase the life of refractories.

Porcelain Enamels

"Lakefield" nepheline syenite when used in enamels will lower smelting temperatures or lessen time of firing. The alumina content of enamels may be increased without increasing the hardness of enamels.

It can be used to advantage as a mill addition with soft frits for sheet steel ground coat enamels.

Glazes

Numerous laboratory and plant tests have proved that "Lakefield" nepheline syenite is an excellent glaze material due to its low fusion.

Electrical Porcelain

"Lakefield" nepheline syenite tends to promote more gradual vitrification and gives a wider firing range which in turn promotes greater uniformity in the strength and other properties of the ware.

It can be used to produce high strength porcelains at somewhat lower temperatures. When firing to normal temperatures it should be used in reduced proportion.

Hotel China

If a lower firing temperature is not desired when using nepheline syenite, it is better to reduce or eliminate the auxiliary flux rather than to use a reduced amount of nepheline syenite. Bodies without auxiliary flux warp less and have good strength. A good hotel china body is obtained when dolomite is used with nepheline syenite and when the firing is done two to three cones lower.

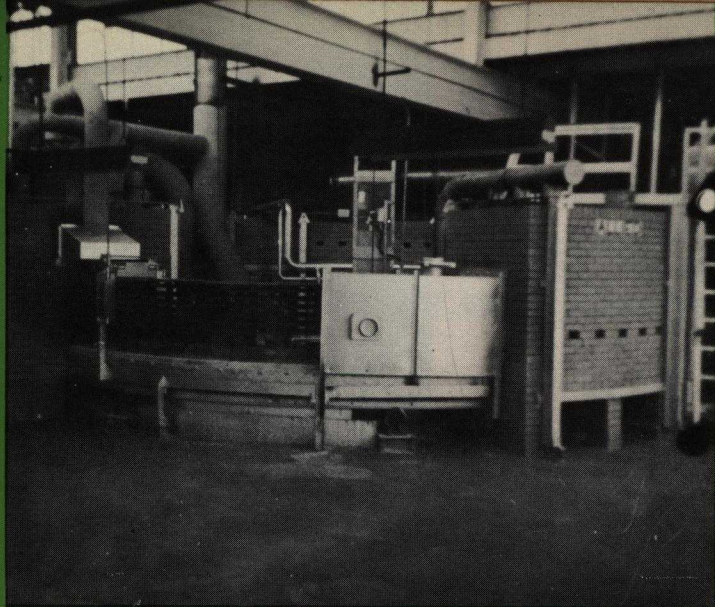
Technical Service

Our research department will be glad to assist you in using "Lakefield" nepheline syenite in your product. Write the sales agents for further details regarding the economies and improvements you can obtain, and the bulletin containing results of research work on low temperature vitreous bodies.



**A COMPLETE SERVICE
FOR
THE CERAMIC INDUSTRY**

Allied Engineering Division • Ferro Corporation
Cleveland, Ohio



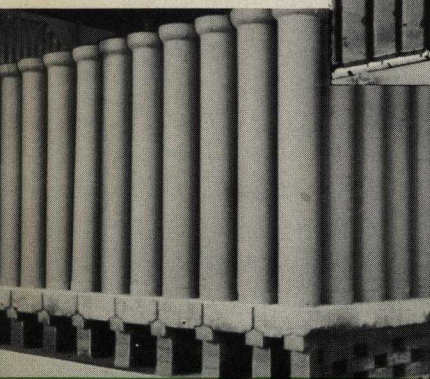
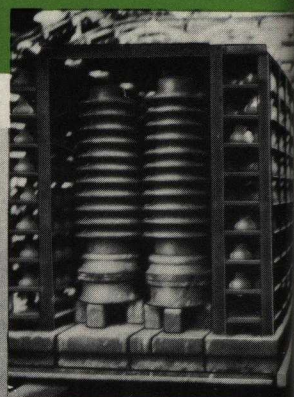
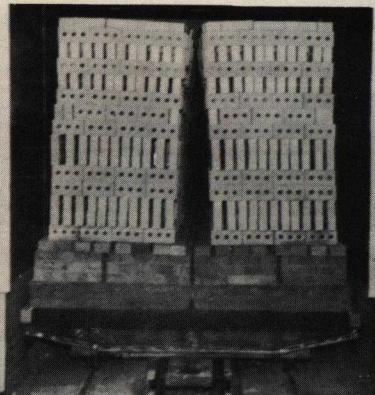
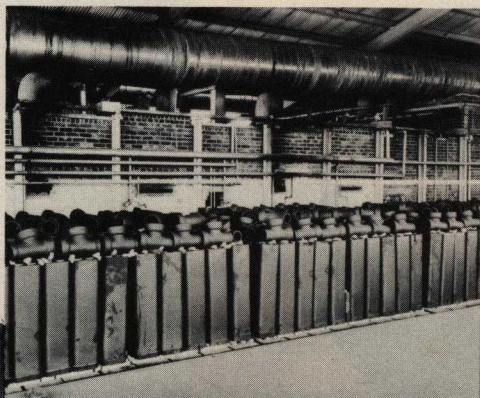
ALLIED

Complete Ceramic Plant Layouts

Representative Allied installations can be found in practically every country in the world . . . operating efficiently and economically for the production of all types of ceramic ware. Allied straight, circular, direct fired or portable tunnel kilns are designed for the most economical use of fuel, whether gas, oil, coal, electricity, or any combination of these heat sources.

Allied's more than 600 designs and installations are an outstanding record—unmatched anywhere.

Whether it's a conversion of your present firing equipment, or a complete new kiln installation, Allied Engineering Division of the Ferro Corporation is a dependable source for all your ceramic requirements.

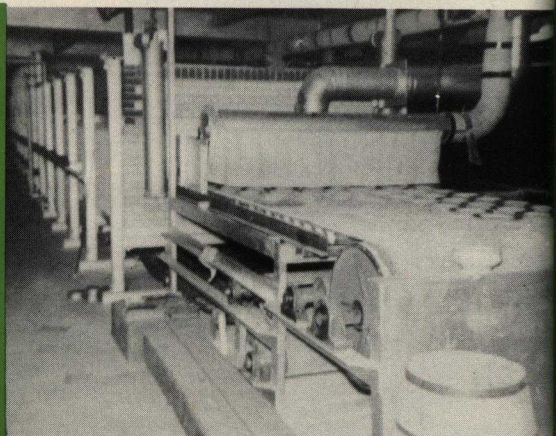


Kilns

No matter what the product—structural clay items, dinnerware, vitrified china, electrical porcelain, floor and wall tile, abrasives, crucibles or sanitary pottery—Allied is the kiln installation preferred by engineers who demand topflight results.

Dryers

Experienced Allied engineers are qualified to design, build or service any type dryer used in ceramic production. Humidity and atmospheric controls are included as required and many are engineered to heat entirely from the waste of tunnel and/or periodic kilns.



Allied Engineering Division
FERRO CORPORATION

4150 EAST 56th STREET • CLEVELAND 5, OHIO

CESCO REFRACTORY SPECIALTIES

7 reasons why CESCO pressed and cast refractories last longer...save you money:

1. Low Thermal Expansion of CESCO Refractories provides the extra "factor of safety" needed for longer life on the fastest firing cycles.

2. High Structural Strength is "built in"—through both advanced product design and body composition.

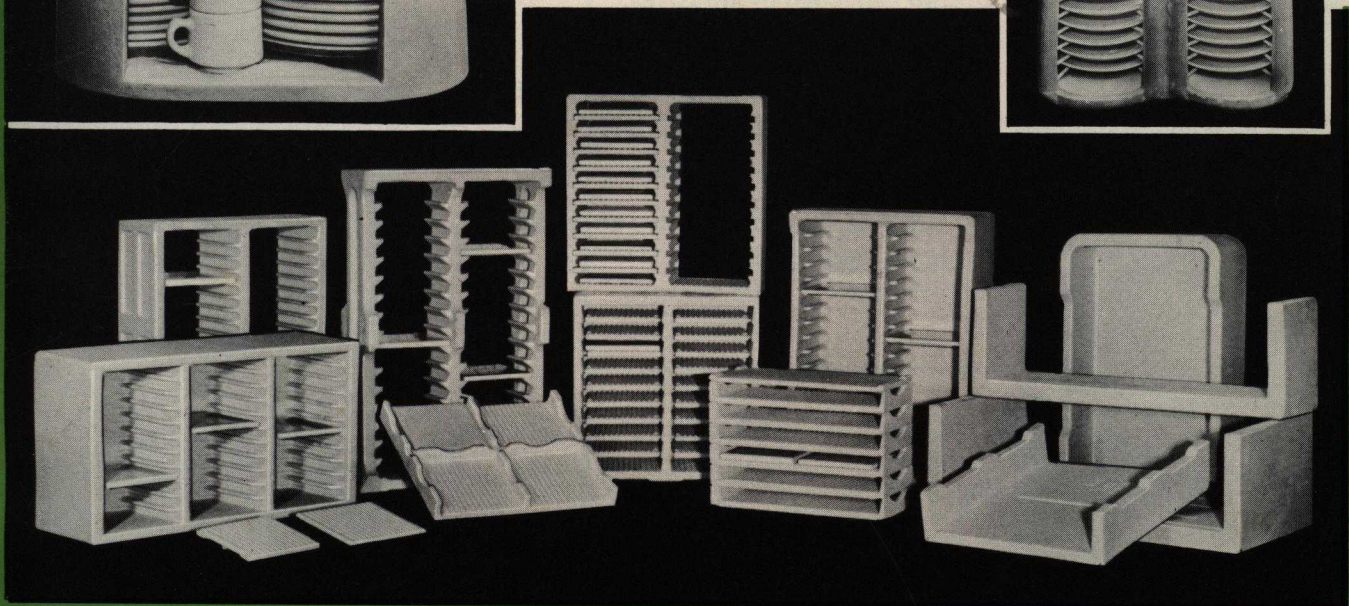
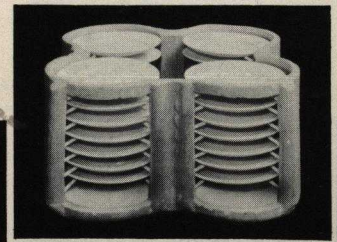
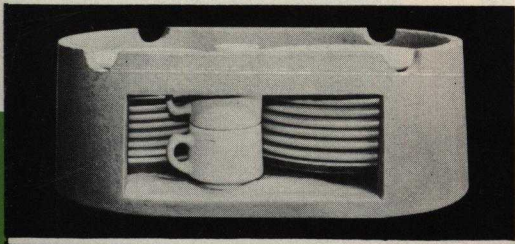
3. High Abrasion Resistance of improved mixes reduces both sagger wear in handling and dirt losses in glaze firing.

4. High Resistance to Glaze Lifting minimizes blistering and peeling, lengthens product life, reduces dirt losses.

5. High Forming Pressures increase refractory "strength to weight" ratio and effective payload per cubic foot of kiln placing space.

6. Rigid Quality Checks on raw materials maintain product uniformity and performance.

7. Continuous Research toward still further product improvement is in *your* behalf—to lick *your* problems, reduce *your* costs, increase *your* profits.



Cesco makes a complete line of saggers, setters, slabs, posts, and special shapes developed for manufacturers of ceramic products. We recommend, if you are not using CESCO Refractories,

that you plant test them now. Test them—compare them—analyze their lower cost and longer performance. Then specify CESCO. To set up *your* test program, write us today!



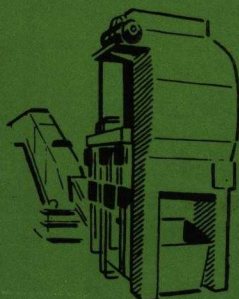
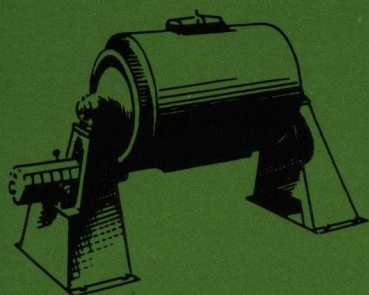
CERAMIC SUPPLY COMPANY

Division of Ferro Corporation

CROOKSVILLE, OHIO



COMPLETE EQUIPMENT AND SUPPLIES SERVICE FOR THE CERAMIC INDUSTRY

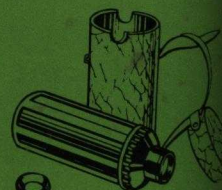
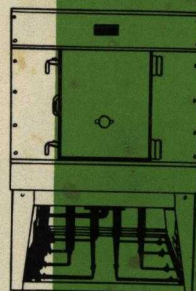
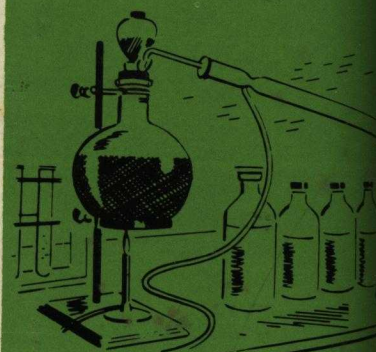
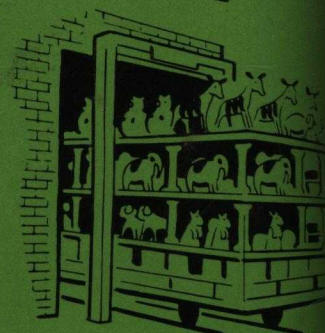
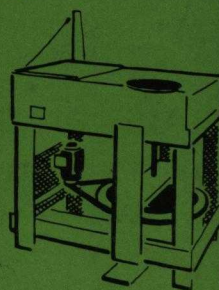


Allied Engineering Division of the Ferro Corporation distributes a complete line of materials, production supplies and equipment for the clay products industries. Everything needed for forming, decorating; for kilns, dryers; for handling, shipping; for the laboratory; and also equipment for control departments is available from Allied.

Ask, too, about the new, production-proved *Ejectopump*. It's designed especially for pumping pottery slip and other harsh abrasives.

For complete plant layouts, for engineering equipment and supplies, stains, glazes, kilns and dryers... make Allied your one dependable source.

Write for detailed information and prices.



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FRITS FOR SHEET STEEL . . . coverage in sheet steel from base coat application through cover coat with any color or degree of finish.

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GLAZES . . . specially developed glazes to meet individual requirements and customer specifications. Experienced APEC engineers create custom finishes to fill any need.

ENAMELING CLAYS . . . suspension materials consistent in quality with other products bearing the APEC trademark.

**A
RELIABLE,
GROWING
SOURCE
OF SUPPLY
TO THE
CERAMIC
INDUSTRY...**

SERVICE . . . though field service problems are a rarity. APEC maintains an expert staff of field personnel for consultation and service to customers.

CONTROL . . . exhaustive tests and checking at every stage of production, and batch type smelting permit APEC to guarantee consistent quality. Raw materials, material in process and finished products are subject to continual, precise quality control procedures.

RESEARCH . . . to answer questions, solve production problems and help customers make better, more efficient use of porcelain enamel products, APEC maintains a complete laboratory and experienced staff of specialists in frits. You can look to APEC for help, and for new products, processes and methods under development in our own laboratory.



american porcelain enamel company



ABBÉ ENGINEERING CO.

Dept. 51, Hudson Terminal Building
50 CHURCH ST., NEW YORK 7, N. Y.
Offices in Principal Cities in U. S. and Canada

SPECIALISTS IN GRINDING, PULVERIZING AND MIXING EQUIPMENT FOR THE CERAMIC INDUSTRY

Abbé Engineering has been serving the ceramic, glass, structural clay and allied industries for well over a half-century. For grinding, pulverizing, blending and mixing, Abbé-Engineered Equipment is unsurpassed in versatility, efficiency, convenience and economy.

- BALL MILLS
- JAR MILLS
- PEBBLE MILLS
- BREAKERS
- JAR ROLLING MACHINES
- PULVERIZERS
- CONICAL BLENDERS
- LABORATORY MILLS
- PUMPS, VACUUM
- CRUSHERS
- SIFTERS
- GRANULATORS
- MIXERS
- TUBE MILLS

PEBBLE MILLS • BALL MILLS • TUBE MILLS for Pulverizing, Wet or Dry Grinding or Mixing Glaze, Colors, Frit, etc.

Modern Abbé Mills, developed and manufactured by Abbé Engineering, one of the pioneer mill manufacturers, offer design improvements and advantages to meet the demands of high speed, consistently high product quality production. Greater output is provided in each mill size.

ABBÉ PEBBLE MILLS—Lined mills of all-welded heavy gauge rolled steel plate with heavily ribbed, flanged steel heads—maximum capacity, strength and absolutely leakproof construction. Mill linings are usually pure white, hard, vitrified porcelain or Buhrstone (Silex) blocks, or can be of metal alloy, rubber or wood.

ABBÉ BALL MILLS—Unlined mills made of abrasion-resistant, extra heavy gauge, high carbon or chrome manganese alloy steel with specially designed baffling for increased grinding and dispersing action and longer mill life—none can outperform the Abbé Ball Mill.

ABBÉ TUBE MILLS—Mills for continuous open or closed circuit, wet or dry grinding using balls, pebbles or rods. Same rugged, long wearing construction as in the Abbé Ball Mills. Available in all mill sizes.

STYLES AND DRIVES—MILL STYLES: Style GPH with gear mounted on mill head—used in most operations, compact, minimum floor space; Style GPS with gear mounted on main drive shaft—ideal for dust-proof dry grinding; and, Style BS with pulley or gear mounted on main drive shaft—for small mill sizes only. **MILL DRIVES:** Standard drives available with motor or pulley drives with V-belt, silent or roller chain, direct geared or variable speed motors.

WRITE FOR NEW PEBBLE AND BALL MILL CATALOG NO. 77.

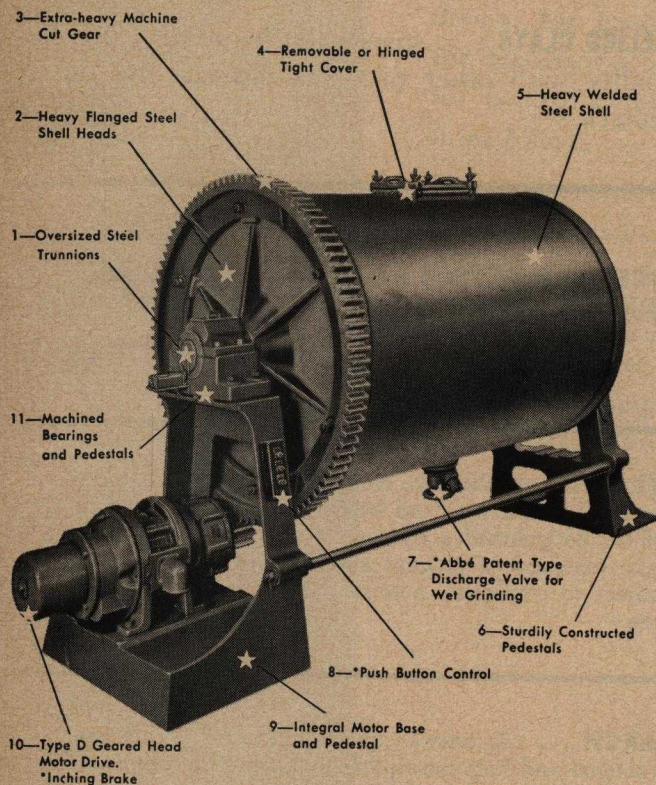


Fig. P-73A—Features of Abbé Pebble or Ball Mill, Style GPH, with Type D geared head motor drive and optional Type R inching device, push button control and Abbé patent discharge valve.

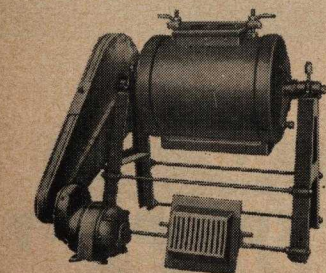


Fig. P-96—Standard Mill, Style BS, with roller chain and gear motor drive.

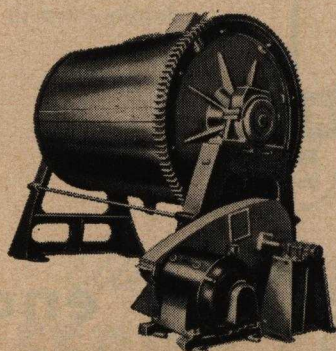


Fig. P-63—Standard Mill, Style GPH, with motor drive.

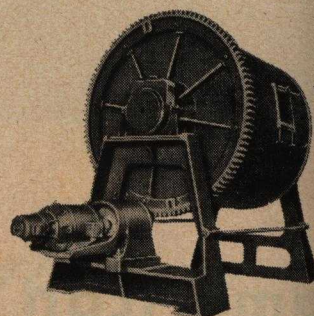


Fig. P-73—Standard Mill, Style GPH, with gear motor unit drive and automatic inching device for spotting and holding mill in desired position.

ABBÉ ENGINEERING CO.

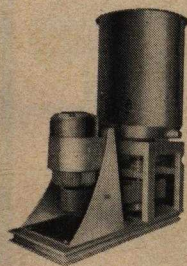
CAPACITIES OF ABBÉ PEBBLE AND BALL MILLS



Mill No.	Size Inside Steel Cylinder Inches		PEBBLE MILLS												STEEL BALL MILLS					
			Total Mill Volume—Gals. without Pebbles or Balls	Operating Capacity with 50% Charge of Pebbles or Porcelain Balls				50% Charge				Total Mill Volume Gallons without Balls	Operating Capacity with 33% Charge of Steel Balls							
				Dry Grinding Sand—Lbs.		Wet Grinding Maximum Grinding Charge—Gals.		After Thinning in Mill Total Gallons		of Pebbles Lbs.			of Porcelain Balls—Lbs.		Dry Grinding Sand Lbs.	Wet Grinding Maximum		33% Charge of Steel Balls Lbs.		
	Diam.	Length	Porcelain Lined	Buhr-stone Lined	Porcelain Lined	Buhr-stone Lined	Porcelain Lined	Buhr-stone Lined	Porcelain Lined	Buhr-stone Lined	Porcelain Lined	Buhr-stone Lined	Porcelain Lined	Buhr-stone Lined		Gallons of Grinding Charge	Gallons after Thinning			
0	90	120	2850	2824	9500	9413	1710	1694	1995	1977	19000	18800	16150	16000	3304	13216	2312	2643	44000	
1C	72	120	1770	1755	5900	5850	1062	1053	1239	1229	11800	11700	10000	9950	2115	8460	1480	1692	28200	
1BB	72	108	1587	1572	5290	5240	952	943	1111	1100	10600	10500	8990	8220	1903	7612	1330	1522	25400	
1B	72	96	1404	1389	4680	4630	842	833	983	972	9350	9150	7956	7350	1692	6768	1184	1353	22500	
1AA	72	84	1221	1206	4070	4020	732	724	855	844	8150	8050	6919	6480	1480	5920	1036	1184	19700	
1A	72	72	1037	1022	3456	3410	622	613	726	715	6900	6800	5876	5620	1269	5076	888	1015	16900	
1	72	60	854	839	2846	2800	512	503	598	587	5700	5600	4839	4750	1057	4228	740	845	14000	
2B	60	72	700	689	2333	2300	420	413	490	482	4650	4600	3960	3920	881	3524	616	705	11700	
2A	60	60	575	566	1916	1890	345	340	402	396	3800	3750	3260	3220	734	2936	513	587	9800	
2	60	48	452	442	1506	1475	271	265	316	309	3000	2900	2560	2520	587	2348	411	469	7800	
3C	54	60	457	457	1525	1525	274	274	320	320	3050	3050	2590	2590	595	2380	416	476	7900	
3B	54	54	408	408	1360	1360	245	245	286	286	2700	2700	2310	2310	535	2140	374	428	7100	
3A	54	48	359	359	1200	1200	215	215	251	251	2400	2400	2030	2030	475	1900	332	380	6300	
3	54	42	310	310	1035	1035	186	186	217	217	2050	2050	1750	1750	416	1664	291	333	5500	
3½A	48	60	368	368	1225	1225	221	221	258	258	2450	2450	2090	2090	470	1880	329	376	6300	
3½	48	48	289	289	965	965	173	173	202	202	1900	1900	1640	1640	376	1504	263	301	5000	
4B	45	60	320	320	1070	1070	192	192	224	224	2140	2140	1800	1800	413	1652	289	330	5500	
4A	45	48	251	251	840	840	151	151	176	176	1670	1670	1420	1420	330	1320	231	264	4400	
4½	42	48	216	216	720	720	129	129	151	151	1450	1450	1220	1220	288	1152	201	230	3800	
5A	36	50	160	160	535	535	96	96	112	112	1050	1050	900	900	220	880	154	176	2950	
5	36	42	132	132	440	440	79	79	92	92	880	880	750	750	185	740	130	148	2450	
6B	30	42	97	87	323	290	58	52	68	61	650	570	550	490	128	512	90	102	1700	
6A	30	36	82	74	273	245	49	44	57	51	550	480	460	400	110	440	77	88	1470	
6	30	30	67	60	223	200	40	35	47	41	450	400	380	340	92	368	64	73	1200	
7	30	24	52	46	173	153	31	27	36	32	340	300	300	250	73	292	51	58	975	
8½C	24	36	49.4	43.5	164.6	145	29.6	26.1	34.6	30.4	330	280	280	240	70	280	49	56	930	
8½B	24	30	40.4	35.4	134.6	118	24.2	21.0	28.3	24.8	270	230	230	200	58	232	41	46	770	
8½A	24	24	31.4	27.2	104.6	90	18.8	16.2	22.0	19.0	210	180	180	150	47	188	33	37	625	
8½	24	18	22.4	19.0	74.6	63	13.4	11.4	15.7	13.3	150	120	130	100	35	140	25	28	465	
8	18	24	16.0	13.3	53.3	44.3	9.6	8.0	11.2	9.3	105	90	90	70	26	104	18	21	350	
9	18	18	11.4	9.3	38.0	31.0	6.8	5.6	8.0	6.5	75	60	70	50	20	80	14	16	265	

In dry grinding, material charge is based on sand at 100 lbs. per cu. ft., with other materials in proportion to their relative weights. In wet grinding, with mill one-half full of pebbles or balls, maximum grinding charge is 60% of the total mill volume and maximum charge after

thinning with mill filled to the top is 70% of the total mill volume; with mill one-third full of pebbles or balls, the maximum grinding charge is 70% of the total mill volume and maximum charge after thinning with mill filled to the top is 80% of the total mill volume.



ABBÉ DISPERSALL MIXER

Rapid dispersion of thick or thin fluids, abrasives, glazes, blending of colors, etc. Particularly valuable in reworking slip scrap, whatever its condition, plastic, wet or bone-dry. Produces thorough homogeneous dispersion in minimum time. Easy to clean. Made in sizes from 1 to 330 gallons, in any metal; with V-belt drive and motor or pulley drive. Write for Catalog No. 78.

Fig. M-72 — 330-gallon Abbé Dispersall Mixer, Slurry Type, used for casting slip scrap.

ABBÉ CONICAL BLENDERS

Low cost mixing and blending of dry materials without grinding material, hardening particles or generating heat in the mix. Polished smooth interiors for quick easy cleaning. Sizes from 1 to over 175 cubic feet. Write for Bulletin No. 72.

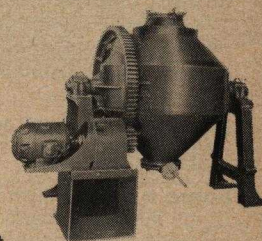


Fig. M-63 — Style GPH—Double Conical Blender

ABBÉ JAR MILLS AND JAR ROLLING MACHINES

For pulverizing, grinding, mixing ceramic materials, wet or dry, in small batches per jar from one quart to 60 gallons.

JAR MILLS—Wide range of capacities in single and multiple jars in any desired combination for processing batches of the same or different materials. Jars are one piece porcelain but are also available in any metal. Flint pebbles, porcelain or metal

balls are used as grinding medium. Write for Jar Mill Catalog No. 73.

JAR ROLLING MACHINES—Made in any desired length with two, three or four rollers in single or multiple tiers for any size, number or combination of jars. Convenient, compact, easy to place and remove jars or other containers. Write for Jar Rolling Machine Catalog No. 79.

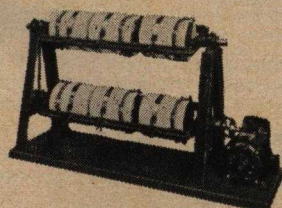


Fig. J-35—Style P, 6-Jar Mill, with gear motor and roller chain drive.

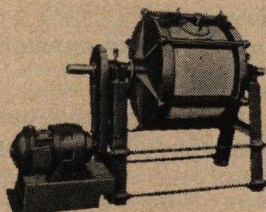


Fig. J-120—Eureka No. 3 Jar Mill with parallel gear motor and roller chain drive.

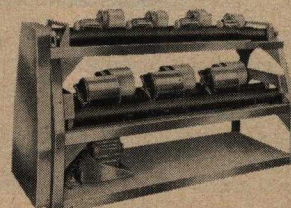


Fig. J-111—Style P, two-tier Jar Rolling Machine with three rollers per tier.

AMERICAN POTASH & CHEMICAL CORPORATION

EXECUTIVE OFFICE: 3000 WEST SIXTH STREET, LOS ANGELES 54, CALIFORNIA



TRADEMARK

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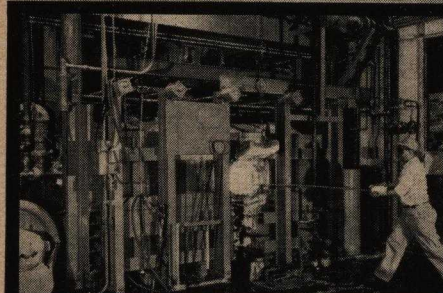
PLANTS & SHIPPING POINTS:

Trona and Los Angeles, California
Henderson, Nevada
San Antonio, Texas
(American Lithium Chemicals, Inc.)
(San Antonio Chemicals, Inc.)

Aberdeen, Mississippi
West Chicago, Illinois
(Lindsay Chemical Division)

EXPORT DIVISION: 99 Park Avenue, New York 16, New York

Diversified Chemicals for Industry



BORON CHEMICALS

BORAX. Sodium Tetraborate, technical 99.5% $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$. Grades: coarse and fine granular, powdered.

V-BOR®. Refined pentahydrate borax, technical 99.5% $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$, 47.5% B_2O_3 ; a concentrated and refined grade of sodium tetraborate.

TRONABOR®. Crude pentahydrate borax $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$; agricultural 46% B_2O_3 minimum.

PYROBOR®. Dehydrated borax, technical 99% $\text{Na}_2\text{B}_4\text{O}_7$, 68.5% B_2O_3 . Grades: standard and fine granular.

BORIC ACID. Orthoboric or boracic acid, technical 99.7% H_3BO_3 . Grades: granular, powdered, technical & U.S.P.

SODIUM PENTABORATE
Technical 98.3% $\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 10\text{H}_2\text{O}$, 58% B_2O_3 minimum; granular.

BOROTHERM®. Paint-grade borate, technical 57% B_2O_3 .

BORO-SPRAY®. High solubility agricultural borate. Contains sodium pentaborate.

BORIC OXIDE. Anhydrous boric acid, high purity; minimum 98.5% B_2O_3 . Grades: flake, minus 20 mesh, minus 60 mesh.

BORON Elemental. Amorphous, high purity. Grades: standard 90-92%, special grades.

POTASSIUM CHEMICALS

MURIATE OF POTASH. Potassium chloride, agricultural and industrial grades 95-98% KCl (60% K_2O minimum), regular and granular; Chemical grade (99.7% KCl minimum); U.S.P.

SULPHATE OF POTASH. 96-98% K_2SO_4 (51% K_2O minimum). Grades: industrial and agricultural.



LITHIUM CHEMICALS

LITHIUM CARBONATE. Technical 98.5% Li_2CO_3 (40% Li_2O).

LITHIUM HYDROXIDE MONOHYDRATE

BIKALITH® LEPIDOLITE. Lithium ore $\text{LiKAl}_2\text{F}_2\text{Si}_3\text{O}_9$.

LITHIUM CHLORIDE
LITHIUM BROMIDE

BROMINE CHEMICALS

BROMINE. Technical 99.5% Br_2 minimum.

ETHYLENE DIBROMIDE. $(\text{CH}_2\text{Br})_2$ technical.

METHYL BROMIDE. CH_3Br ; High purity gas compressed to water white liquid. Practically C.P. quality.

THORIUM, RARE EARTH & YTTRIUM CHEMICALS

Lindsay Chemical Division
WEST CHICAGO, ILLINOIS

SPECIALTIES & SEMI-COMMERCIAL PRODUCTS

SULFUR DIOXIDE. Commercial grade, purity over 99.9%.

LITHIUM—Metal and other chemicals.

RUBIDIUM & CESIUM CHEMICALS
Chlorides, sulfates, carbonates and fluorides.

INORGANIC BORON COMPOUNDS
ORGANO-BORON COMPOUNDS

ALKARB®. Alkali metal carbonate mixture containing potassium, rubidium and cesium carbonates.

ELECTROCHEMICALS

SODIUM CHLORATE

Technical 99.5% NaClO_3 .

POTASSIUM CHLORATE

99.5% KClO_3 . Grades: technical & ordnance.

POTASSIUM PERCHLORATE

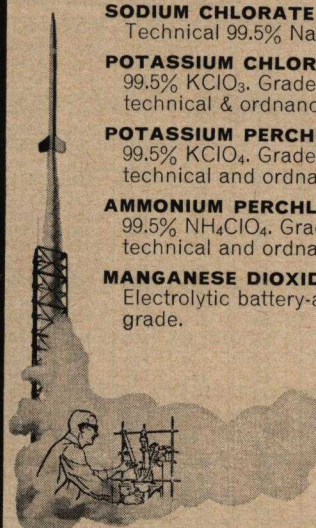
99.5% KClO_4 . Grades: technical and ordnance.

AMMONIUM PERCHLORATE

99.5% NH_4ClO_4 . Grades: technical and ordnance.

MANGANESE DIOXIDE

Electrolytic battery-active grade.



REFRIGERANTS

METHYL CHLORIDE. Supplied in 2-lb. disposable Charg-A-Can* containers; also in 6, 24, 70, 100, 145 and 300 lb. cylinders.

SULFUR DIOXIDE. Supplied in 1 lb. disposable Charg-A-Can* containers; also in 10, 35, 100, 150 and 300 lb. cylinders.

REFRIGERANT-11. Supplied in 115 and 230 lb. drums.

REFRIGERANT-12. Supplied in 95/100 lb. disposable Charg-A-Can* containers; also in 10, 25 and 145 lb. cylinders.

REFRIGERANT-22. Supplied in 2 lb. disposable Charg-A-Can* containers; also in 9, 22 and 125 lb. cylinders.

REFRIGERANT-114. Supplied in 1 lb. disposable Charg-A-Can* containers; also in 10, 25 and 150 lb. cylinders.

*Trademark of AP&CC



SODIUM CHEMICALS

SODA ASH. Sodium carbonate, technical 58% Na_2O . Grades: granular and fine granular.

SALT CAKE. Sodium sulphate anhydrous, 99% Na_2SO_4 minimum. Grades: regular and industrial (99% Na_2SO_4).

AMERICAN PULVERIZER COMPANY

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1269 Macklind Ave., St. Louis 10, Mo.

Originators and Manufacturers of Ring Crushers and Pulverizers

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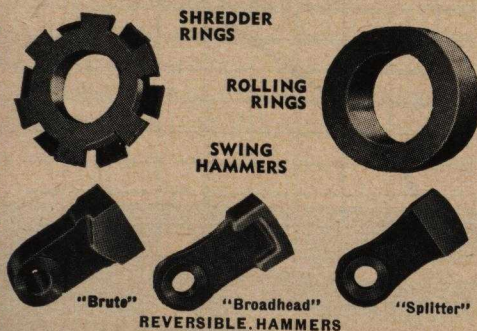
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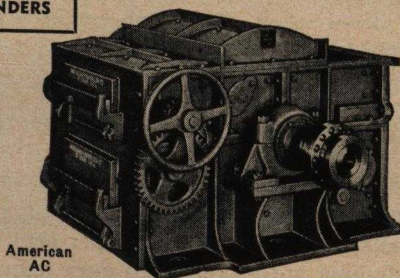
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1482 Madison Avenue
NEW YORK 17, N. Y.
Howard L. Hill
101 Park Ave.
Phone:
Murray Hill 5-5195
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Titzel Engineering &
Equipment Co.
260 42nd St.
Phone: ATLantic 1-0215

AMERICAN HAMMERMILLS AND ROLLING RING CRUSHERS

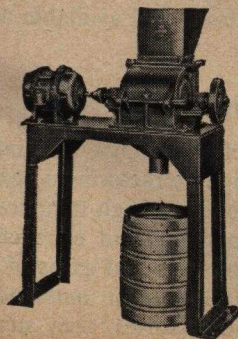
REDUCTION ACTION TO FIT EACH JOB!



FINE GRINDERS



For rapid reduction of glass, tank cullet, rock salt, coal, limestone, phosphate rock and other types of friable and fibrous materials. Patented shredder rings, through rapid impact, reduce materials to uniform size with a minimum of fines and no oversize. Capacities up to 500 TPH.



LABORATORY MILLS

To provide required crushing action for each specific class of material these mills are custom-built . . . afford efficient, economical operation for small scale, continuous reduction for disposal operations and for laboratory and pilot plant needs. They handle a wide range of friable and fibrous materials. Can be equipped with manganese steel Rolling Rings, Shredder Rings, or Swing Hammers. Capacities up to 2000 lbs. per hour.

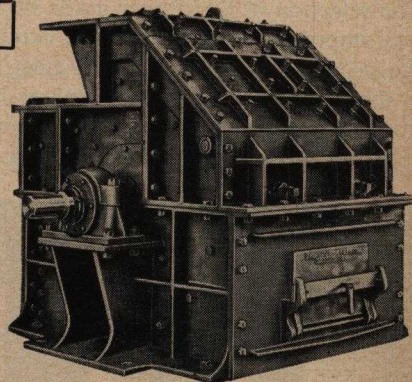
Custom built—to assure better reduction at low cost for each particular job — American hammermills and ring crushers offer efficient uniform reduction of all raw materials used in the ceramic industry.

The American Pulverizer Company will be glad to recommend the most efficient crusher for your specific job. Write for illustrated literature and complete details.

For Crushing: Cullet, Grog, Limestone, Clays, Rejects, Dry Pan Tailings

AMERICAN ACS FRONT FEED

American ACS Crushers assure efficiency, economy and flexibility for any size crushing job in one-step, or closed circuit operation. Special center feed design lengthens the travel—gives a higher ratio of fines. Conventional front feed type assures minimum fines. Sturdy, sectional construction . . . dust-tight machined joints . . . and extra heavy manganese steel breaker plate, grinding plate and crushing chamber lined for long, trouble-free service. Handles all hardness of friable and fibrous materials—capacities up to 250 TPH.

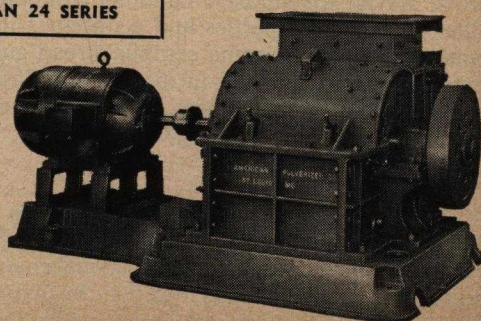


AMERICAN HAMMERMILL

American Hammermills are used principally for the reduction of "one-man" size stone or screen rejects to aggregate or agricultural sizes in one operation. Recommended for grinding and shredding all kinds of fibrous and friable materials. Rigidly constructed with compactness that requires only minimum headroom. Equipped with SKF bearings, metal trap, alloy-steel shaft, and manganese liners. Sectional construction. Three types of hammers available—to fit specific requirements of the job. Capacities up to 100 TPH.

AMERICAN 24 SERIES

Rapid production, plus uniform reduction of screen rejects in circuit operations, is provided by the American "24" Series Crusher. Used with swing hammers for grinding and shredding a wide variety of minerals and fibrous materials. (Furnished with hammer or ring rotor.) Custom-built to fit specific job requirements. Capacities up to 55 TPH.



ALUMINUM COMPANY OF AMERICA

CHEMICALS DIVISION
1207 Alcoa Building, Pittsburgh 19, Pa.

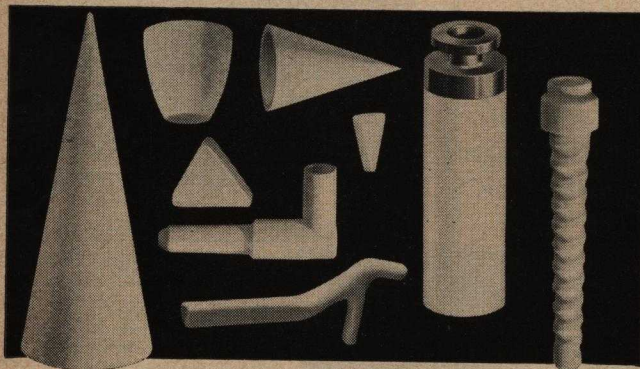


ALCOA ALUMINA

Alumina has long been an important raw material for the ceramic industry, and Alcoa's development of a number of commercial grades having a wide variety of physical properties has greatly increased the field of application in the industry. Alcoa's technical staff is available to help you in the selection of the proper grade for your particular application.

GRADES OF ALUMINA DIFFER

The selection of the proper grade of alumina is often of vital importance. Alcoa has had extensive experience in the production of aluminas to meet specific needs and in the application of those aluminas in ceramic production. This experience is available through our Chemicals Division. Your inquiries are invited.



NEW APPLICATIONS

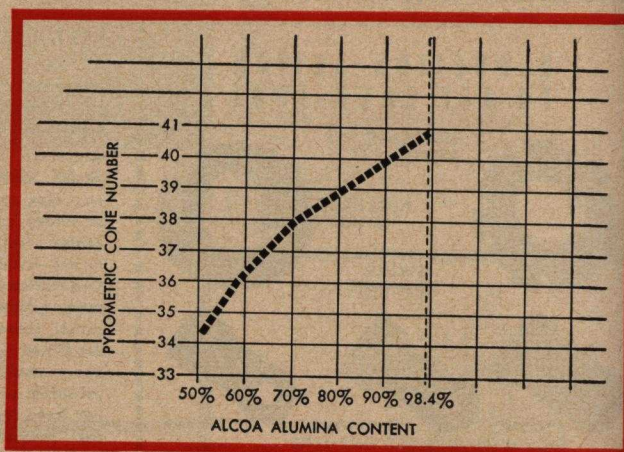
Alumina ceramics are being used in a number of new applications. For example, ceramic metal cutting tools improve machining; mill linings and grinding balls reduce contamination and improve economy. Development of jet engines was also substantially aided by aluminum oxide insulators: ordinary insulators couldn't take the heat. High alumina ceramic pump parts and pipe linings improve service for abrasive handling equipment. Alumina fillers improve properties and economics in plastic and synthetic resins. Alumina ceramic thread guides have set new performance records in the textile industry especially in handling synthetic fibers. Many more developments are in the experimental stage.

VITREOUS ENAMELS

Alumina is used extensively by the enamel industry. It aids in promoting opacity in zirconia enamels and improves reflectance. It also improves brilliance and bonding power of some enamel compositions.

REFRACTORIES

The use of high alumina refractories has become general and extensive only within the past ten to fifteen years. The rapid increase in their use has resulted from improvement in quality through better manufacturing



This graph illustrates how the pyrometric cone equivalent of refractories increases with the alumina content. (Data, courtesy of Harbison-Walker Refractories Company.)

methods, improved raw materials and a demand for refractories to meet more rigid service conditions.

By fortifying alumina-bearing raw materials with crystalline alumina and by the use of Tabular Alumina, high alumina refractories ranging from 50 per cent to over 99 per cent alumina are produced to meet temperature conditions up to 3500° F. The limit of service is in almost direct ratio to the percentage of alumina in the refractory. Tabular Alumina is a fully shrunk aluminum oxide converted to the corundum form and available as massive crystals.

CHARACTERISTICS

The outstanding characteristics of these high alumina refractories include: extremely high refractoriness, exceptional strength and volume stability at high temperature, high resistance to thermal spalling and excellent resistance to the corrosive action of slags and gases of a wide range of composition. Because of these outstanding properties of high alumina refractories, they now lead all other types for glass tank construction.

ALCOA ALUMINA

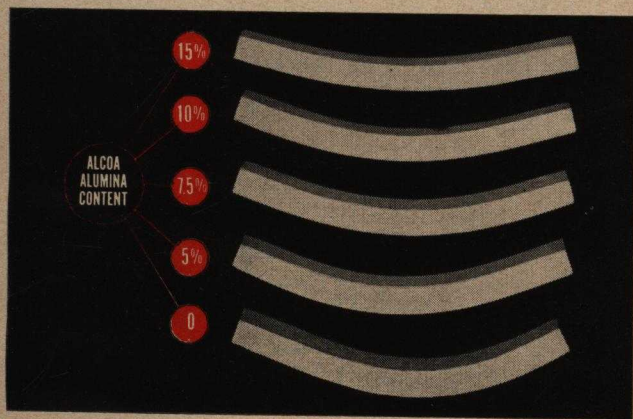
KILN FURNITURE

The life of kiln furniture may be greatly extended by fortifying some of the compositions in general use with a modest percentage of alumina. This is to be expected since the same outstanding characteristics which have resulted in the rapid rise in the use of high alumina brick and glass tank refractories are equally important in kiln furniture.

High alumina refractories are finding an ever-expanding use in a variety of industries in addition to those already cited. These include applications in the steel and non-ferrous metal industries, in the oil, lime and cement industries, and for boiler setting and fire-box construction.

WHITEWARE BODIES (Vitreous and Semivitreous)

Addition of alumina to whiteware bodies reduces deformation in firing, decreases quartz inversion, lengthens the firing range, increases strength (both transverse and compressive) and improves whiteness. Special grades of alumina, when incorporated in amounts up to 20 per cent in a wide variety of bodies, improve mechanical properties of those bodies without appreciably affecting the production control of shrinkage, firing schedule and maturing temperatures. The accompanying illustration shows the effect of various percentages of alumina (up to 15 per cent) on deformation.



These five ceramic specimens were fired to 2320° F in about 30 hours. Cone 10 averaged 5 o'clock at end of firing. The specimen containing 15 per cent alumina had 38 per cent less deformation than the one containing no alumina.

GLAZES

The use of alumina in glaze compositions offers worthwhile advantages. It prevents sagging at higher firing temperatures, increases brilliance of colors, improves mechanical and thermal shock resistance, and increases resistance to corrosive liquids and weathering.

GLASS

Alumina imparts valuable properties to almost any type of commercial glass. It is an important constituent of low expansion glass, such as that used for thermometers, cooking ware, chemical apparatus and medical glass. It also is used extensively in optical glass and fine tableware.

Authorities list the following qualities obtained by the use of alumina in the glass mix:

- Lower coefficient of expansion, hence more resistance to thermal shock.
- Lower thermal conductivity.
- Higher mechanical strength, both crushing and tensile.
- Greater brilliance and luster.
- Harder surface.
- Improved working qualities. These include a longer working range, making the glass more suitable for machine operation and easier for the craftsman to shape.
- Decreased devitrification.
- Increased resistance to weathering and attack by liquids.

ELECTRONIC CERAMICS

Service requirements of electrical insulators vary widely. Electrical requirements are met by a variety of insulator compositions in service at ordinary temperatures. Mechanical properties of such insulators may be greatly improved by increase of the alumina content of these insulator compositions.

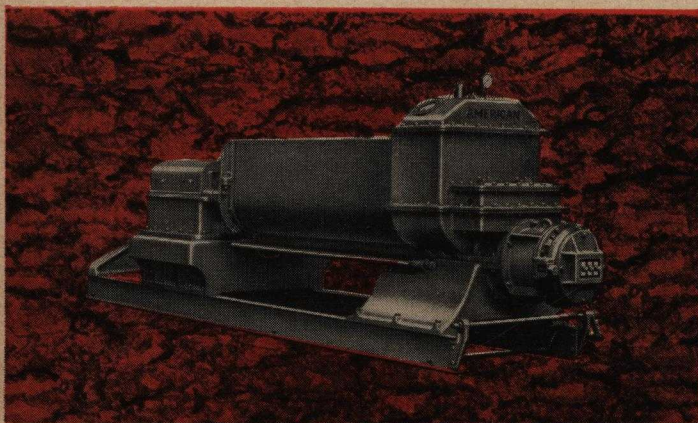
Many insulators operate under conditions where thermal expansion, mechanical strength, refractoriness, resistance to heat shock, resistance to chemical agencies and good electrical properties over a wide range of temperatures are of vital importance. Insulators containing more than 90 per cent of alumina have been found best for meeting these severe service conditions. Special high purity aluminas developed by Alcoa find wide use in insulator manufacture.



AMERICAN CLAY MACHINERY

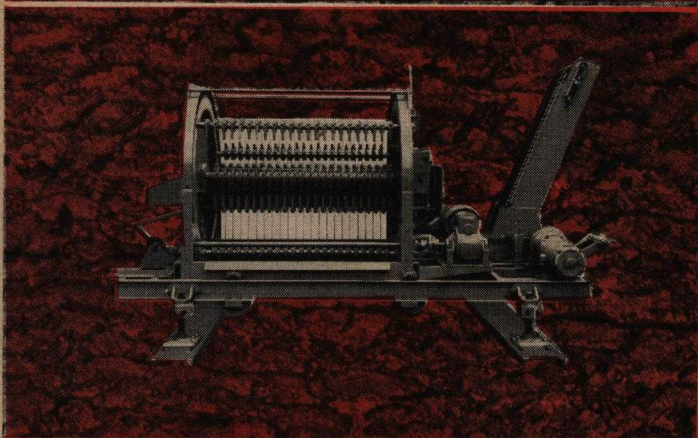
Division of Huber-Warco Company
MARION AND BUCYRUS, OHIO

American . . . FOR PROFITABLE CLAY PRODUCTION



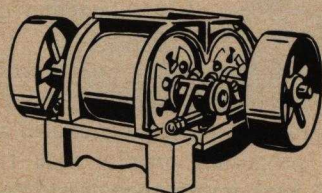
AMERICAN DE-AIRING COMBINED MACHINES

Machine handles building, fire or paving brick, also hollow block and drain tile. Capacity range is from 3,000 to 18,000 building brick per hour or 10 to 40 tons of hollow ware per hour. This capacity is governed by the clay used, size and kind of ware manufactured and by the operating speed.

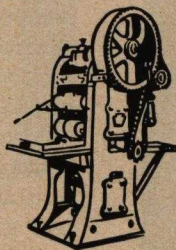


AMERICAN AUTOMATIC ELECTRIC CUTTERS

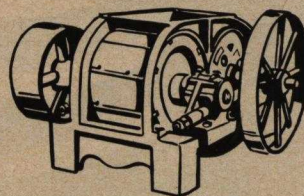
Hourly capacity is 3,000 to 18,000 bricks . . . 23 standard bricks per cut. Every motion is electrically controlled to give precision accuracy of any brick or tile cut up to 14"x14". The cutter is a complete unit, there are no extras needed. Hinged measuring frame can be lifted to give necessary room to change die or front.



SMOOTH ROLL CRUSHERS



REPRESSES



DISINTEGRATORS

Before you buy, investigate the profit-producing features of "American" clay machines. A vast background of actual installation experience gained on jobs throughout the world enables "American" to design and outfit a complete plant from pit to kiln, or solve any phase of a brick or tile production problem.

LOOK TO *American* FOR THESE
CLAY MACHINES

Extruding Machines
Dry Pans
Grinders
Pug Mills

Represses
Wet Pans
Auger Brick Machines
Automatic Cutting Tables

Crushers & Disintegrators
De-Airing Equipment
Roofing Tile Machinery
Conveyors & Elevators

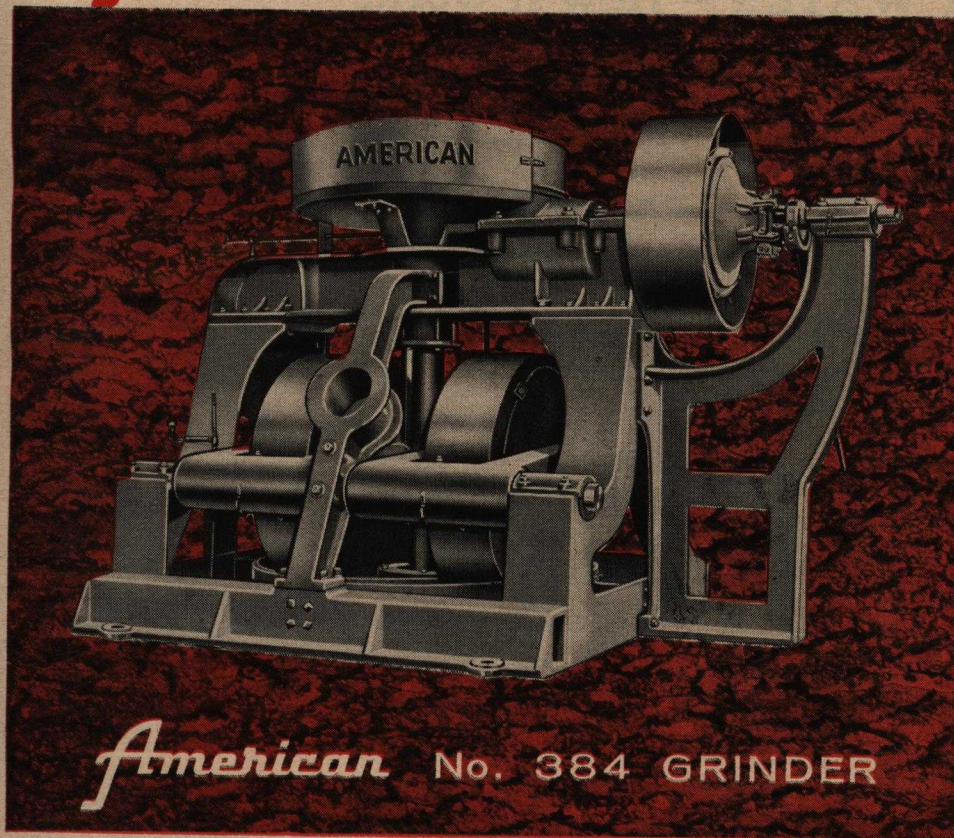
and such accessory items as dies, screens, barrows, trucks, clay cars, winding drums.

AMERICAN CLAY MACHINERY

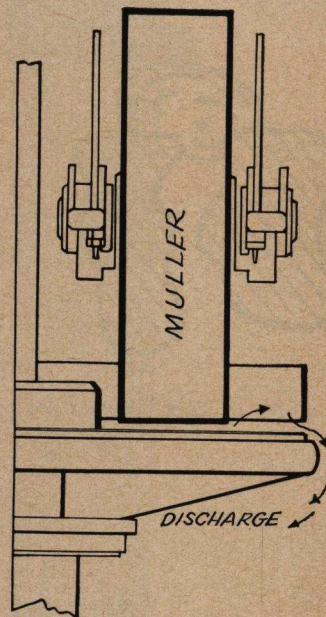
Division of Huber-Warco Company
MARION AND BUCYRUS, OHIO

American

TRADITIONALLY THE BEST



American No. 384 GRINDER



GRINDS WITHOUT CLOGGING

Crushed material is thrown off by centrifugal force between the moveable liner walls of rim and revolving base. Moist material does not clog opening . . . discharge is positive.

A TON A MINUTE PRODUCTION CAPACITY

The "American" No. 384 Grinder has been designed to handle big volume grinding . . . A TON A MINUTE capacity. It will efficiently handle hard clay, shale and other similar material used in the manufacture of brick and other clay products.

Materials can be handled wet or dry with the "American" No. 384 Grinder . . . there are no screen plates to clog or slow down production. Other important features include: low initial investment . . . requires a minimum of valuable plant floor space . . . less power consumption . . . and performs efficiently and dependably with only a minimum of maintenance.

Other "American" Grinders range in capacity of from 15 to 80 tons per hour. Investigate the production features of "American" Grinders . . . consistently specified by experienced clay manufacturers.

American
A Division of HUBER-WARCO COMPANY
Marion, Ohio, U.S.A.

Plants in Marion and Bucyrus, Ohio
Cable Address: HUBARCO

CLAY MACHINERY

OVER A CENTURY OF EXPERIENCE IN THE
MANUFACTURE OF CLAY MACHINERY

AQUADYNE CORPORATION

89 Terminal Ave., Clark, New Jersey

Phone FULton 1-3036

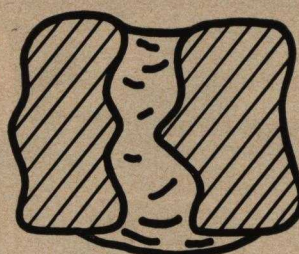
AQUADYNE WET WATER – How it works



PLAIN WATER

Plain water droplets have "thick skin" or high surface tension. They are not attracted to a solid surface. Here is a typical

plain water droplet between two grains of clay.



AQUADYNE WET WATER

The surface tension or "skin" of plain water is lowered from 72 dynes to 30 dynes when the AQUADYNE wetting agent is

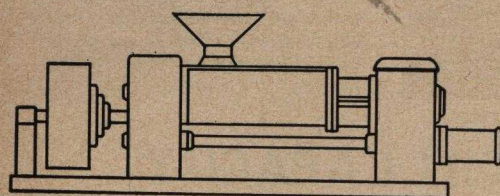
added. Here is an AQUADYNE WET WATER droplet between two grains of clay.

APPLICATIONS

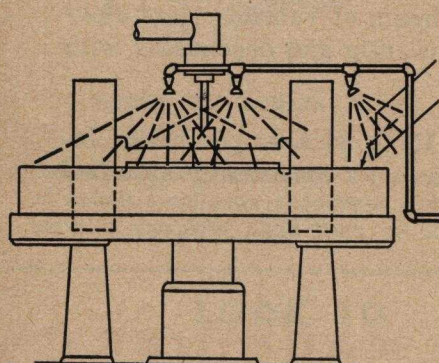
FOR PRODUCT BLENDING

With AQUADYNE WET WATER the following advantages are immediately obtainable in product blending:

- Minimum moisture required
- Clay lumps and balls eliminated
- Acts as lubricant for extrusion
- Speeds up drying time
- Reduced surface cracks
- Fewer broken pieces
- Faster mixing
- Better plasticity
- Denser, smoother product
- Wear on dies reduced
- Less broken corners



Aquadyne aids mixing in the pug mill and lubricates extrusions.



Aquadyne method of controlling dust on dry pan mixers

With AQUADYNE WET WATER production can be increased without the cost of new and larger equipment.

FOR DUST CONTROL

Anywhere where water can be used to control dust, AQUADYNE WET WATER does the job fast and with positive effectiveness. At crushers, mills, mixers, screens, driers, floors, unloading kilns, AQUADYNE WET WATER sprays can control dust. In mills and mixers the AQUADYNE WET WATER used for controlling dust can also serve as the moisture additive for mixing.

FOR CLEANING

In cleaning mixing equipment AQUADYNE WET WATER circulated for reasonable time periods cleans out encrustation in blungers and other mixing equipment. Saves time and labor because the high penetration power of AQUADYNE WET WATER quickly loosens the encrustations.

AQUADYNE SYSTEM

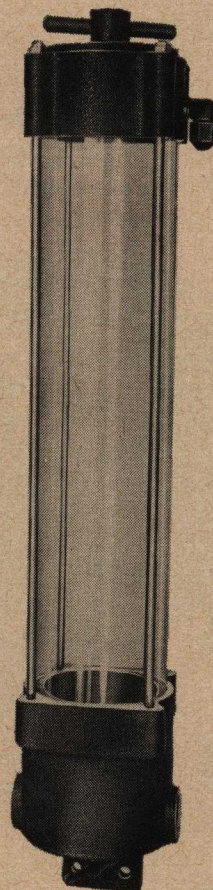
The AQUADYNE system consists of the AQUADYNE HYDROBLENDER and the concentrated AQUADYNE wetting agent capsule.

The three pound AQUADYNE wetting agent capsule, placed in the HYDROBLENDER, produces up to 1,000 to 1,200 gallons of WET WATER.

The AQUADYNE wetting agent capsule is specially formulated to provide WET WATER which will attract solid particles of either positive or negative charge.

AQUADYNE is neutral (pH 7.4) and will not precipitate the salts encountered in hard water. Neither efficiency nor solubility are affected by hard water. It is non-toxic, non-inflammable, non-corrosive, odorless and harmless to skin and clothing.

This is the
Aquadyne Hydroblender
(Type 758)



INSTALLATION & OPERATION

The HYDROBLENDER is mounted in any place convenient for loading capsules, turning input water on and off, and draining.

If desired, the AQUADYNE System can be fully automatic in operation. Any signal source, such as material moving on a belt, can turn on a switch which in turn opens a valve and starts AQUADYNE WET WATER

flowing. Flow stops automatically when no material is left on the belt. Similar hook-ups may be made to provide automatic stop and start, using other signal sources.

Automatic drainage can be provided if final outlets are above outlet of HYDROBLENDER. The HYDROBLENDER operates effectively at pressures from 30 to 125 psi.

WRITE FOR LITERATURE AND PRICES

AQUADYNE CORPORATION

89 Terminal Avenue

•

Clark, N. J.

Phone FULton 1-3036

ARMSTRONG CORK COMPANY

950 Mulberry Street, Lancaster, Pa.

District offices in all major cities

INSULATING FIRE BRICK AND CEMENTS

Insulating Fire Brick

Armstrong Insulating Fire Brick are made with high insulating value and high strength in a well-balanced ratio. In almost every application, the combination of these two properties means efficient furnace performance and low maintenance expense.

In addition to providing low thermal conductivity and high strength, Armstrong Insulating Fire Brick have many other advantages. These lightweight brick are uniformly sized to assure a fast, neat job with heat-tight joints. Because of their even texture and ruggedness, these brick have a fine-grained, dust-free surface that allows mortar to key securely for a strong bond. Highly resistant to shrinking and spalling, Armstrong Insulating Fire Brick can be used directly exposed in equipment fired with gas, oil, electricity, or powdered coal.

Refractory Cements

Armstrong C199 Cement is an air-setting refractory mortar, ideal for use with all types of fire clay brick and insulating fire brick. A joint of C199 Cement is actually stronger than the average fire brick it bonds. It takes a firm set at room temperature and maintains this strength over its entire working range. C199 Cement is highly resistant to abrasion, slagging, and spalling and has sufficient refractoriness to meet all A.S.T.M., A.R.I. and U.S. Navy Standards for super-duty mortar at 2910° F.

Armstrong No. 26 Bonding Mortar is well suited for application where bond strength can be moderate. It develops its bond when exposed to temperatures over 1800° F. Below this temperature, No. 26 Bonding Mortar can be used for laying up brick as backup insulation, allowing the brick to be salvaged for later reuse.

Send today for complete catalog containing full details and performance data. Address Armstrong Cork Company, 950 Mulberry Street, Lancaster, Penna.



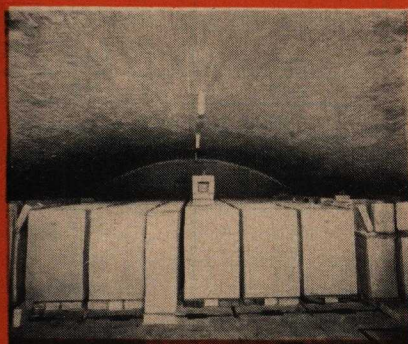
PHYSICAL PROPERTIES OF ARMSTRONG INSULATING FIRE BRICK

Type	A-20	A-23	A-25	A-26	A-28
Maximum Hot Face Temperature.....	2000F.	2300F.	2500F.	2600F.	2800F.
Modulus of Rupture (lbs./sq. in.)**					
Test Method: A.S.T.M. C93.....	95	125	110	125	125
Compressive Strength (lbs./sq. in.)**					
Test Method: A.S.T.M. C93.....	175	300	225	275	225
P.C.E. No.**	23	26	29	32	36
Test Method: A.S.T.M. C24					
Corresponding Softening Point.....	2921F.	2950F.	3018F.	3123F.	3279F.
Weight per 9-inch Straight—lbs.*.....	2.2	2.6	2.35	2.80	3.0
Weight, lbs. per cu. ft.*.....	37.5	44.4	40.1	47.8	51.2
Spalling Loss—per cent*.....	8.0	10.0	10.0	5.0	
Shrinkage, Linear Change, per cent*					
Test Method: A.S.T.M. C210.....	0.5	0.75	1.35	2.0	1.5

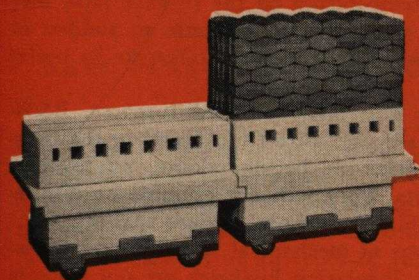
*Maximum Average Value

**Minimum Average Value

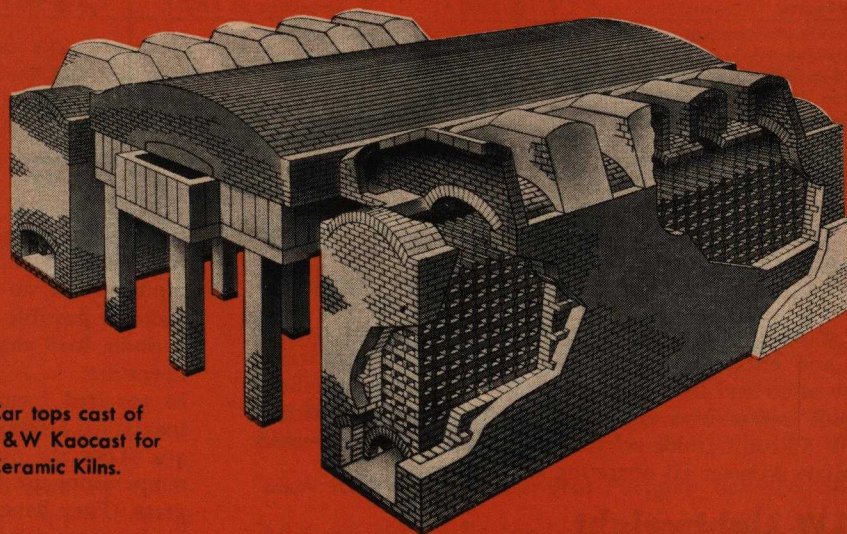
B&W REFRACTORIES



Interior of High Temperature Ceramic Kiln built with B&W Refractories.



Car tops cast of B&W Kaocast for Ceramic Kilns.



Large quantities of B&W Refractories are going into the construction of glass tanks.

B&W Firebrick

B&W ALLMUL

For severest service, B&W offers Allmul, an electric-fused mullite firebrick, at a price far lower than you would expect for its high-level performance. This important economic advantage is the result of mass production methods developed by B&W engineers. Previously, the few available refractories in the quality range of Allmul have been used only in the most difficult applications. Now, this exceptional fused-mullite refractory can be used extensively and economically.

B&W Allmul has a *true* mullite composition. It consists of large, interlocking mullite crystals and a small percentage of corundum. There is no free silica. The strong massive structure of the mullite crystals is produced by using an electrically fused grog in connection with an unusually high final burning temperature.

As a result, B&W Allmul offers the following properties:

- High melting point—it will not shrink at temperatures up to 3200 F
- Unusually high resistance to thermal shock
- Low and regular thermal expansion
- Exceptional volume stability
- High hot-load strength
- Slag resistance

B&W Allmul-D has a dense, low-porosity structure and is designed for exceptional resistance to the penetration of glass batch ingredients.

B&W Allmul Available in Many Forms

In addition to being available in all standard 2½-inch and 3-inch series, B&W Allmul may be ordered in special shapes and sizes. In addition, it is available in the form of grain and as a ramming mix.

B&W 80 AND JUNIOR FIREBRICK

The B&W line also includes B&W 80 and Junior Firebrick. The longer life of these heavy-duty brick is due to their marked resistance to spalling, exceptional load carrying capacity at high temperatures and negligible shrinkage. These firebrick are made from a kaolin of uniform purity and high refractoriness by the B&W high-temperature, double-burning process—which accounts for their excellent stability under load at high temperatures.

Range of Applications. For oil-fired furnaces with slagging, flame impingement and spalling conditions, either B&W 80 or Junior Firebrick can be used. 80's assure uninterrupted service at extremely high ratings. Juniors are recommended where load bearing and temperature requirements are less severe, but too severe for the best grades of fireclay brick.

B&W 80-D, like B&W Allmul-D, has a dense low-porosity structure for exceptional resistance to penetration of glass batch ingredients.

B&W Firebrick

properties	B&W ALLMUL	B&W ALLMUL-D	B&W 80	B&W 80-D	B&W JUNIOR
recommended use limit, F.....	3200	3200	2950	2950	2850
weight, average, lb/cu foot.....	154	159	139	151	135
weight, average, lb/9" straight...	9.00	9.30	8.10	8.85	7.88
fusion point, F.....	3335	3335	3190	3190	3173
hot-load strength, % deformation 25 psi, 1½ hours.....	less than 2% @ 3050 F	less than 1.2% @ 3050 F	less than 1.0% @ 2640 F	less than 0.5% @ 2640 F	less than 1.5% @ 2640 F
modulus of rupture, average, psi (ASTM C-133-39).....	1500	4000	1500	4000	1500
porosity, %, (ASTM C-20-46).....	22-24	17-19	16-20	7-10	16.5
permanent linear change, %, (reheated 5 hours).....	less than 0.5% exp. or shrink. @ 3200 F	no expansion less than 0.5% shrinkage @ 3200 F	less than 1.0% shrink- age @ 2912 F	less than 0.8% shrink- age @ 2912 F	less than 1.5% shrinkage @ 2912 F
approximate chemical analysis, %					
Alumina, Al ₂ O ₃	76.2	76.2	45.1	45.1	41.2
Silica, SiO ₂	20.1	20.1	51.9	51.9	53.4
Iron Oxide, Fe ₂ O ₃	0.9	0.9	1.4	1.4	1.9
Titanium Oxide, TiO ₂	2.5	2.5	1.7	1.7	2.3
Calcium Oxide, CaO.....	Trace	Trace	0.1	0.1	0.05
Magnesium Oxide, MgO.....	Trace	Trace	Trace	Trace	0.2
Alkali as Na ₂ O.....	0.1	0.1	0.3	0.3	0.4

B&W SILICON CARBIDE

For those applications which require refractories to give fast and effective transfer of heat or unusual resistance to abrasion and flame attack, B&W offers a line of silicon carbide refractories. Made at B&W's Augusta Works, B&W Silicon Carbide refractories are available in a variety of mixes to meet all operating requirements.

B&W Lightweight Insulating Firebrick

B&W Insulating Firebrick offer the low heat-conductivity of efficient insulation plus the ability to withstand direct exposure to furnace heat. The lightweight, porous structure of these dual-purpose brick gives them exceedingly high insulating values and low heat storage capacities.

B&W Insulating Firebrick thus shorten heating-up time and make possible substantial fuel savings. Since they rapidly come up to temperature on the furnace face, they make it possible to achieve rapid response to sudden or periodic load changes—a very important feature in boiler operation.

In gas-fired furnaces and many oil-fired furnaces, B&W Insulating Firebrick are used directly exposed in the furnace. They do not shrink or become dense, up to their temperature use limits. They will not crumble or disintegrate. They have a high resistance against spalling. Under some conditions of mechanical abrasion and where active slag is present, Insulating Firebrick are not suitable for direct exposure, and heavy firebrick are used for inner linings. In such cases, B&W Insulating Firebrick offer many important benefits when used as backing-up insulation. They have the highest insulating value available plus the stability that is essential for satisfactory service.

B&W Insulating Firebrick

properties	B&W K-1620	B&W K-20	B&W K-23	B&W K-26	B&W K-28	B&W K-30
service temperatures, F:						
exposed.....	1600	2000	2300	2600	2800	2900
backing up.....	2000	2000	2300	2600	2800	2900
weight, avg., lb/cu ft.....	18.8	25.3	25.9	41.6	42.5	50.5
weight, avg., lb/9" straight.....	1.10	1.48	1.52	2.44	2.49	2.96
fusion point, F.....	2700	2750	2750	3000	3190	3190
conductivity btu/sq ft/hr/deg F/in (ASTM C-182-47):						
500 F.....	0.69	0.90	0.84	1.46	1.43	1.95
1000 F.....	0.95	1.18	1.09	1.84	1.76	2.50
1500 F.....	1.24	1.46	1.34	2.32	2.12	3.15
2000 F.....	....	....	1.65	3.10	2.54	4.05
hot-load strength % deformation under 10 lb/sq in. load, 1½ hr., at temp. indicated:						
1600 F.....	0.0	....	....	....	....	....
2000 F.....	0.2	0.1	....	....	....	....
2200 F.....	....	....	0.1	0.3	0.3	0.2
reheat shrinkage at temp. of (F):	2000	2000	2250	2550	2750	2800
{ K-1620, K-20, K-23, K-26—heating schedule at the rates specified by ASTM C-210-46 K-28, K-30—ASTM C-113-46 }	0.0	0.0	0.1%	0.4%	0.6%	0.5%
cold crushing strength lb/sq in.—average.....	48	95	117	154	148	308
modulus of rupture lb/sq in.—average.....	41	68	103	166	183	283

B&W Refractory Plastics

B&W Refractory Plastics consist of refractory calcines or ores blended with carefully selected clays and mixed with sufficient water to bring them to proper working consistency. On firing, a ceramic bond is formed when the temperature passes the vitrification point.

Refractory Plastics are used to speed furnace construction and maintenance and to eliminate the need for a large inventory of special shapes. The type of application generally determines whether a plastic or a castable should be selected.

B&W PLASTIC MOLDABLE

Is widely used for burner openings, small door openings, capping walls, lining high temperature inspection and access doors, forming special shapes in place and patching deeply spalled or eroded brickwork. Properly installed, Plastic Moldable will give performance comparable to that of the firebrick in the main lining.

It has a use limit of 3100 F, melting point 3245 F, very small linear change, no measurable shrinkage and exceptionally high spalling resistance.

B&W PLASTIC CHROME ORE

Which has a melting point of 3100 F, is chemically neutral and highly resistant to abrasion, and to the effects of acid or basic slags under both oxidizing and reducing conditions. Plastic Chrome Ore is used in such applications as floors and hearths of all types of furnaces, tap holes, etc.

B&W Refractory Castables

The primary purpose of B&W Refractory Castables is to reduce the cost of furnace construction and maintenance. They can do this because:

1. They are as easy to use as structural concrete, and thus speed up construction. They can be poured, plastered or gunned into place.
2. They can frequently eliminate expensive kiln-fired special shapes—thus saving money in new construction and avoiding delays in repair work.
3. They provide inexpensive protection to non-refractory furnace members.

B&W Refractory Castables are widely used by ceramic furnace builders and operators in such important application as:

- Fabricating special shapes—burner tile, peephole blocks, T-tile, shiplay tile, etc.—either in place or on a mass production basis.
- Lining furnace floors or complete furnaces, particularly those requiring extensive use of special shapes.
- Lining doors and other movable furnace sections.
- Lining stacks, dampers, flues, ducts, etc.
- Protecting furnace steelwork, or ordinary concrete foundations.
- Backing up dense firebrick.
- Capping refractory walls.
- Patching spalled or eroded brickwork.

B&W Refractory Castables Include the Following

B&W KAOCRETE-32—Special High Temperature Service—To 3200 F

B&W KAOCAST—High Temperature, General Purpose Use—To 3000 F

B&W KAOCRETE-A—General Purpose Use—To 2600 F

B&W KAOCRETE-B—For Ease of Plastering in General Purpose Use—To 2300 F

B&W KAOCRETE-D—For Extra Strength and Abrasion Resistance—To 2500 F

B&W KROMECAST—Chrome-base Castable for Resistance to Attack of Slag and Other Reactive Products—To 3100 F

B&W HYDROCHROME—Chrome-base Castable for Resistance to Attack of Slag and Other Reactive Products—To 2800 F

B&W KAOLITE—These insulating concretes combine refractoriness, lightweight and low heat conductivity with the ability to be poured like ordinary concrete. For temperatures up to 2200 F. Special mixes are furnished for cement gun application.

3

properties	density lb/cu ft after firing	use limit, F	permanent linear shrinkage—average %, less than—after heating for 5 hrs. at:				cold crushing strength—psi average—after heating for 5 hrs. at:			
			2000 F	2400 F	2600 F	3000 F	2000 F	2400 F	2600 F	3000 F
B&W Kaocrete-32	134	3200	0.2	0.5	0.5	±0.5	750	2000	3000	4000
B&W Kaocast	126	3000	0.5	0.5	0.5	0.3	400	500	1000	3500
B&W Kaocrete-A	124	2600	0.3	0.2	0.2	...	400	2500	4000	...
B&W Kaocrete-B	103	2300	1.6	...	...	...	250	...	...	...
B&W Kaocrete-D	128	2500	0.3	0.5	...	...	1500	3000	...	...
B&W Kaolite-20	53	2000	0.7	...	...	...	250	...	...	...
B&W Kaolite-22	57	2200	0.4	...	...	...	250	...	...	...
B&W Kromecast	174	3100	0.6	0.7	0.7	1.0	600	1500	3000	4000
B&W Hydrochrome	166	2800	0.7	0.1	0.1	...	300	700	900	...

B&W Mortars

The two broad classifications of refractory mortars are (1) heat-setting mortars and (2) air-setting mortars. Since no single refractory mortar can economically cover all service requirements, B&W has developed a complete series from which you can select the mortar that best meets your conditions.

Quantity • The amount of mortar used for laying either insulating firebrick or heavy firebrick varies according to masonry practice. In order to take into consideration the wide variations in mortar usage, we are indicating a range of quantities. The lower values are for dipped joints and the higher values for trowelled joints.

mortars	maximum service temp.	type of brick to be laid up	quantities required			
			lb. per 1000 brick (see "Quantity" above)	lb. required to brush coat 100 sq. ft.	gals. water per 100 lb. of mortar	
					trowel	dip
B&W High Temperature Mortar (heat-setting)	3000 F	Heavy Firebrick	240 - 300	20	3.1	5.2
B&W Mul-Temp Mortar (heat-setting)	3200 F	Heavy Firebrick	230 - 270	20	2.5	3.8
B&W Mul-Set Mortar (Wet) (air-setting)	3200 F	Heavy Firebrick	300 - 350	22	...	...
B&W Mul-Set Mortar (Dry) (air-setting)	3200 F	Heavy Firebrick	180 - 300	20	2.6	4.0
B&W IFB Mortar (heat-setting)	2900 F	IFB (K-1620, K-20, K-23) IFB (K-26, K-28, K-30)	275 - 300 275 - 300	20	3.1	5.2
B&W Air-Set Mortar (Wet) (air-setting)	3000 F	IFB (K-26, K-28, K-30) Heavy Firebrick	360 - 400 360 - 400	22	...	...
B&W Air-Set Mortar (Dry) (air-setting)	3000 F	IFB (K-26, K-28, K-30) Heavy Firebrick	275 - 300 275 - 300	20	3.0	4.4
B&W Smoothset Mortar (Wet) (air-setting)	2850 F	IFB (K-1620, K-20, K-23) IFB (K-26, K-28, K-30) Heavy Firebrick	220 - 270 220 - 330 260 - 280	22	...	...
B&W Smoothset Mortar (Dry) (air-setting)	2900 F	IFB (K-1620, K-20, K-23) IFB (K-26, K-28, K-30) Heavy Firebrick	160 - 180 190 - 240 190 - 240	20	3.5	6.0
B&W Chrome Mortar (air-setting)	3000 F	Heavy Firebrick	300 - 380	50	2.1	...

B&W Kaowool

B&W Kaowool, a new ceramic fiber, has been used successfully for packing expansion joints on tunnel kiln car tops in the ceramic field.

In the manufacture of Kaowool, pure Georgia kaolin is blown into long white homogeneous fibers which have

excellent refractory and insulating qualities. Kaowool's insulating value compares favorably with materials made of fine glass fibers, with the additional advantage of being able to withstand temperatures up to 2000 F (2300 F for short periods) without change or loss of resiliency. B&W Kaowool is available in bulk or in blankets.

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GAS ANALYSIS

Oxygen-Combustibles Analyzer

Continuously analyzes % Oxygen (an index of excess air) and % Combustibles (an index of fuel-air mixing performance) in the flue gas, and transmits electric signals to a Bailey Receiver Recorder. Unit has a high initial and sustained accuracy.

For details request Product Specification E65-1 for Furnace.

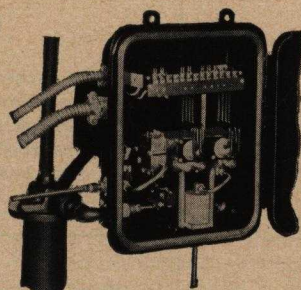


FIGURE 1

Oxygen-Combustibles Recorder

Both measurements are recorded on the same 12 in. chart thus enabling operators to keep fuel burning equipment performing continuously at maximum combustion efficiency. Two pneumatic controllers may be mounted in the same case with Oxygen and Combustibles records.

For details request Product Specification E12-5.

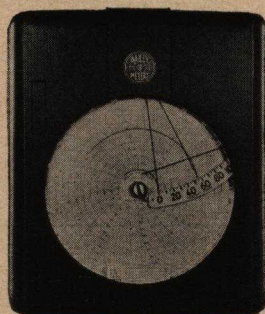


FIGURE 2

Gas Analyzer Package Panel

For indoor or outdoor installation. Includes gas analyzer, sampling equipment, electrical switch gear, and transfer valves for multiple point sampling. The Bailey Gas Sampling System may be used for clean or dirty gases at temperatures up to 3200F.

For details, request Product Specification E65-6.

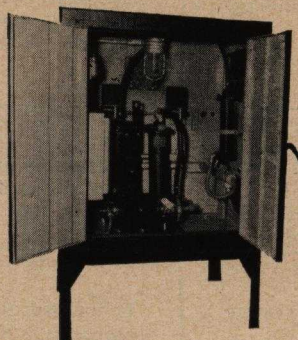


FIGURE 3

HEAT PROVER Analyzer (for portable use)

The famous Cities Service HEAT PROVER Analyzer is now Bailey built and sold. Weighing only 25 pounds, it is a self-contained automatic analyzer including a sampling tip and hose plus a thermocouple for temperature measurement. Instrument dials are dual range for greater accuracy and sensitivity.

For details request Product Specification E65-5.

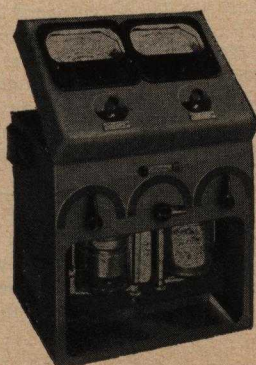


FIGURE 4

FURNACE PRESSURE

Furnace Pressure Controller

Measures and records (or indicates) furnace pressure and transmits a pneumatic signal to remote control equipment. Control system includes a computing relay, hand-automatic selector station, and power unit.

For details request Product Specification M21-1 for Furnace Pressure Controller, P99-1 for Selector Station, and P99-3 for Computing Relay.

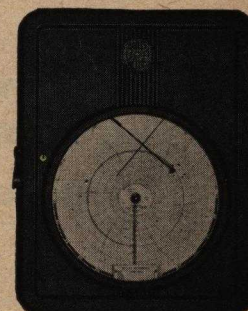


FIGURE 5

Power Unit

Control Drive may be applied to valves, dampers, feeders and other regulating devices. Consists of a double-acting air cylinder, a positioning relay, and a manual operator. Any desired relationship between drive motion and pneumatic signal may be secured.

Available cylinder strokes—4", 8", 16", 30", and 60".

For details request Product Specifications P81-1 and P81-5 and Drawing C5315707.

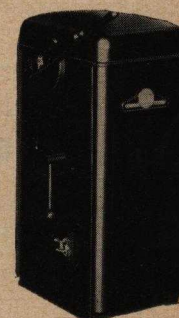


FIGURE 6

FUEL FLOW

Gas Flow Transmitter

Pneumatically transmits linear gas flow measurements to indicating, recording, integrating, and/or controlling equipment at remote stations. Transmitter also indicates flow on a uniformly graduated scale independent of air supply.

Also available is a direct mechanically-operated gas flow recorder for applications where pneumatic transmission is not required.

For details request Product Specifications P22-3 and M22-2.

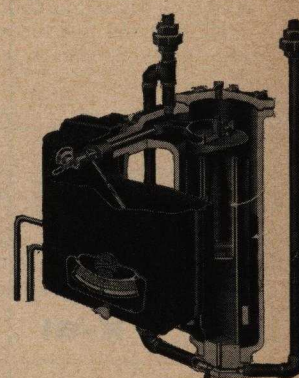


FIGURE 7

Receiver Recorder-Controller

Provides one to four continuous chart records of any measured variables which may be converted into pneumatic or electric control signals. Precalibrated "plug in" units permit easy field adaptation to revised application requirements.

Clogging of recording pens is eliminated by use of an automatic, sealed inking system which provides a normal one year's recording without replacement or refilling.

For details request Product Specification E12-5.



FIGURE 8



BESTWALL CERTAIN-TEED

SALES CORPORATION

120 East Lancaster Avenue, Ardmore, Pa.

EXPORT DEPT.: 100 East 42nd St., New York 17, N.Y.

Manufactured by Bestwall Gypsum Company

	USE	DESCRIPTION
POTTERY PLASTERS	K-55 Especially designed for use by makers of sanitary ware. Used for tank molds, bowl molds, etc.	A pure, evenly textured plaster that remains highly permeable in the set state. Where high absorption is required, this plaster is ideal. Compressive strength at pouring consistency (dry cast): 2300 psi.
	K-56 For general mold work in potteries as jigger molds, casting molds, and in mold and model work. Also used for casting art objects such as plaques, statues, novelties, etc.	This plaster is especially treated during manufacture to give it unusual surface hardness in the set state, providing long mold life at lower production costs. Compressive strength at pouring consistency (dry cast): 2300 psi.
	K-58 For general mold work in potteries when resistance to thermal shock is desired.	Especially treated during manufacture to eliminate cracked molds due to thermal shock. Other properties about the same as those of K-59.
	K-59 For the production of jigger molds in dinnerware plants and in electrical porcelain ware plants. Also excellent for longer-wearing casting molds. As a general mold in all potteries, sanitary ware plants, and in any operation requiring plaster of higher than normal fluidity.	Finer in grind and requiring less mixing water than our regular pottery plasters. Designed for the rigid requirements that demand a highly fluid plaster and freedom from pinholing tendencies. Low water ratio (6½ parts water to 10 parts plaster) makes pieces far stronger and wear resistant than with conventional plasters. Compressive strength at pouring consistency (dry cast): 2800 psi.
	K-60 For mold work in potteries where a lower setting expansion is desired.	Setting expansion materially lowered. Other properties similar to those of K-59.
	K-61 An extra-fine-ground pottery plaster for extra-smooth wearing molds and fine detail.	Formulated at our plant to have the same properties as K-59, but of a much finer grind.
	K-62 An extremely fine-ground pottery plaster designed to give the best possible results in mold wear.	Treated for shock resistance. Powder is white, but gives light blue color in slurry and cast. Produces the most durable, strongest cast of all pottery plasters. Compressive strength at pouring consistency (dry cast): 3200 psi minimum.
PLATE GLASS PLASTERS	To cement plate glass sheets to the grinding tables during grinding and polishing.	Gypsum plasters of the highest purity, grit-free and scratchless, unexcelled as bedding agents. Special formulas to fit all plant conditions.

CUSTOM-MADE PLASTERS

Whatever your requirements, we are ready to work closely with you, and to recommend the specific industrial plaster that will improve your product or raise your plant efficiency. Write or call General Office, Ardmore, Pennsylvania.

	USE	DESCRIPTION
MOLDING PLASTER K-30	Cementing agent in the manufacture of such material as fire brick, insulating brick, ceramic shapes, etc. Also as a mold to form ceramic pieces.	A molding plaster of the highest purity (over 99%) and containing less than 1% of limestone and shale. Setting time adjusted to suit customer requirements.
INDUSTRIAL DENSITE K-6	For casts that demand extremely high strength and low water absorption. Perfectly suited for use with mold materials such as wood, plaster, rubber, clay, metal. As a conditioner for ordinary plasters to obtain intermediate strength.	The strongest and hardest pure gypsum plaster available. At pouring consistency, the tensile and compressive strengths and surface hardness of the dry casts are about five times those made of ordinary plaster. Compressive strength at pouring consistency (dry cast): 9000-10,000 psi.
LOW EXPANSION DENSITES K-12	For case and block molds, patterns and models where great strength, hardness and wear resistance are desirable in a low-expansion material.	This is the strongest hardest low-expansion plaster available today. Its amazingly low expansion—.03 to .04%—makes it ideal where accurate dimensions must be maintained. It has a normal period of fluidity and plasticity. May be mixed with ordinary plasters of intermediate strength and expansion. Compressive strength at pouring consistency (dry cast): 6000 to 7000 psi.
K-13	For patterns, case molds, blocks, slabs, shell casts.	Similar to Densite K-12 except for a slight difference in working characteristics. It is more easily built up, scraped and rodded than K-12, but lower in strength and hardness. Compressive strength at pouring consistency (dry cast): 4300 psi.
K-12-F and K-13-F	For detailed case molds, patterns and models or wherever an extremely fine grind low-expansion plaster is indicated.	Where extreme sharpness of intricate detail combined with unusual surface smoothness is desired, these fine grind versions of Densites K-12 and K-13 are now available. These are the finest grind low-expansion plasters obtainable today. Excellent for production of superior case molds.
DENSROCK "C"	For "Ram" Process dies and general case mold work where reproduction of fine detail with extremely smooth surfaces is desirable.	Densrock "C" is a new gypsum cement designed especially for the production of dies for use in the "Ram" Process of producing ceramic ware. It is extremely fine grind material with good fluidity at a low water-plaster ratio, and reproduces fine detail excellently. Dry compressive strength at pouring consistency: 9000 psi.
CERTROCK	For case molds. Its high fluidity reproduces the finest details, assuring extremely smooth, non-porous surfaces on finished molds.	A high purity gypsum plaster with over twice the tensile and compressive strength of standard plasters, resulting in little breakage. Compressive strength at pouring consistency (dry cast): 4500 psi. (Note. This plaster can not be built up or carved.)

BELL CLAY OPERATIONS

Sales Office, 157 Virginia Avenue, Chester, West Virginia

Mailing Address Box 757, East Liverpool, Ohio — Ph. EV 7-2681



BELL Dark Ball Clay

Grain Size

Less than	
10 Microns.....	98%
-5 Microns.....	97.5%
-1 Micron.....	85.0%
-0.5 Micron.....	75.0%
Hydrogen Ion Concentrated (pH).....	5.20

Chemical Analysis

SiO ₂	54.00%
Al ₂ O ₃	29.41%
Fe ₂ O ₃	.91%
TiO ₂	1.40%
CaO	.35%
MgO	.36%
Other Alkalies	1.01%
Ignition Loss	12.63%

Various Specifications

Water of Plasticity—50% Flint.....	28.10%
Drying Shrinkage—50% Flint.....	6.96%
Firing Shrinkage—50 Flint Cone 9.....	1.55%
Raw Modulus of Rupture (Average) in Lbs.	
Per Sq. In.—50% Flint.....	795
Fired Modulus of Rupture (Average) in Lbs.	
Per Sq. In.—50% Flint Cone 9.....	4100
Absorption (Plastic)—50% Flint Cone 9.....	16.30%
Plasticity	Excellent
Raw Color	Gray-Brown
Fired Color—Cone 9.....	White
Residue Over 140 Mesh Screen.....	1.35%
Fusing Point	Cone 32
Tested for over firing to Cone 18.....	None

Write for data charts on other Popular Bell Ball Clays
Dresden - Gray - Special - Universal - Superior



BELL KAOLIN Bell Sergeant China Clay

Particle Size Distribution

Greater than	
30 Microns	28.0%
30-25 Microns.....	0.5%
25-20 Microns.....	0.5%
20-15 Microns.....	1.0%
15-10 Microns.....	3.0%
10.5 Microns.....	13.0%
5-4 Microns.....	6.0%
4-3 Microns.....	6.0%
3-2 Microns.....	9.0%
2-1 Microns.....	12.0%
1-0.5 Microns	6.0%
Less than 0.5 Microns	15.0%

Chemical Analysis

SiO ₂	44.90%
Al ₂ O ₃	38.90
Fe ₂ O ₃	0.40
TiO ₂	1.32
CaO	0.06
MgO	0.10
Na ₂ O	0.22
K ₂ O	0.20
Ignition Loss.....	14.20

100.30

Physical Properties

Modulus of Rupture	75psi
Water of Plasticity	32.7%
Absorption—Cone 8.....	23.0
Fired Color	White
pH.....	4.5

Write for data on Bell's Rubber Insecticide and Refractory Clays



BELL MINERALS Oxford Feldspar

Perham and LaFlamme mines in Maine are completely mechanized to assure constant uniform product.

Oxford Feldspar Analysis

SiO ₂	69.40
Al ₂ O ₃	17.04
Fe ₂ O ₃	0.09
CaO	0.38
MgO	Trace
K ₂ O	9.72
Na ₂ O	3.22
Loss	0.30

TOTAL 100.15

Screen Test:

Total Residue on 200	0.50
Total Residue on 325	4.50

Make Bell's Maine Feldspar your main source of supply.

BELL RESEARCH, Inc.



Pyrometric Cones

Pyrometric cones are slender trihedral pyramids made from mixtures of ceramic materials in such proportions as to soften at definite intervals under advancing kiln temperatures. As this occurs, the cones bend slowly, and since they can be observed through peep-holes in the kiln, the fireman is thus informed as to the heat conditions in the kiln, the rate of advance of kiln temperatures and the proper finishing point of the ware. Such firing control is their chief use.

Fire-Chek Keys

A specially prepared body makes Bell Fire-Chek Keys the ideal way to check heat measurement accurately. Kiln atmosphere does not affect these Keys. This is most important in the firing of natural clay bodies. Open center design for speedy draw trials.

Fire-Chek Gauge

For accurate reading of Keys. Simple to operate no maintenance needed.

Bell's modern laboratory is dedicated to the accurate checking of materials for the ceramic industry.

BERKSHIRE CHEMICALS, INC.

60 Greenway Drive, Pittsburgh 4, Pa.

Sales Offices:

New York • Chicago • Philadelphia • Los Angeles • Cleveland • Boston • Pittsburgh • San Francisco

You can
always
rely on . . .



GLASS ENAMELS

- Low-firing
- Acid-resistant
- Sulphide-resistant
- Alkali-resistant

ALUMINUM ENAMEL FRITS

- Lead and lead-free

LOW-TEMPERATURE STEEL FRITS

VITROMIX

HIGH-TEMPERATURE REFRACTORY FRITS

VITRO-MATTE

GLAZE STAINS

BODY STAINS

OXIDES

- For glass and porcelain enamel

CHALKBOARD ENAMELS

- For steel, aluminum, aluminized steel

LUBRICATING GLASS

- For steel extrusion dies

Made by Vitro Manufacturing Co. — Sold by Berkshire Chemicals, Inc.—Both component companies of Vitro Corporation of America.

W. N. BEST COMBUSTION EQUIPMENT CO.

417 ELEVENTH ST., CARLSTADT, N. J.



FOR THE CERAMIC INDUSTRY—Engineers, Designers and Manufacturers of Oil, Tar and Gas Burners and Auxiliary Equipment Serving The Ceramic Industry for More Than a Half Century.

PACKAGED FOR QUICK, EASY, BOLT-ON INSTALLATION

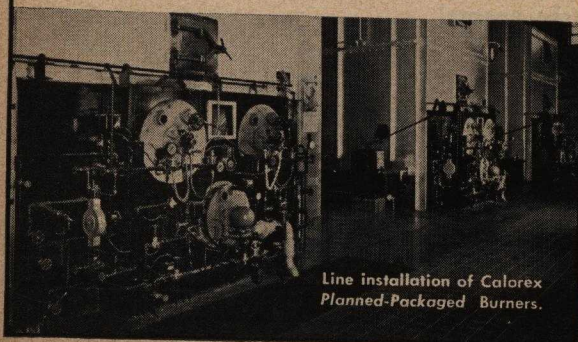


PLANNED- PACKAGED BURNERS

These burners give you the benefits of pacemaking W. N. Best advances in burner design and automatic electronic controls. They are available in models to meet nearly every requirement of industry for electric Power Generation—Steam Generation—Heating—Hot Water—Steam Operating Floating or Mobile Equipment. Advantages include:

- Top burner efficiency with even Bunker C Fuel Oil.
- Fast, simple changeover to gas when more economical.
- Electronic controls that provide for automatic firing and complete boiler room automation.
- Guaranteed combustion performance of 12½% CO₂, without smoke.
- Wide operational range...340 G.P.H. to 25 G.P.H. in a typical model...almost a 14 to 1 turndown ratio.
- Installation flexibility that eliminates crowding and provides for more open space in boiler room.
- The dependability, high efficiency and quiet operation of the remarkable CALOREX ROTO-CUP BURNER...a truly modern burner that represents the most outstanding design improvement in 18 years.

Three Components: 1) Forced draft boiler front, a complete combustion unit; 2) Cabinetrol, a free-standing unit connected with combustion system by a single conduit; 3) Factory Assembled Pump and Heater Set complete in itself except for connecting pipes. The units can be arranged with great flexibility in meeting your boiler room layout requirements.



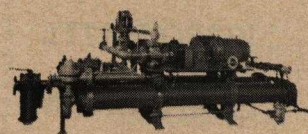
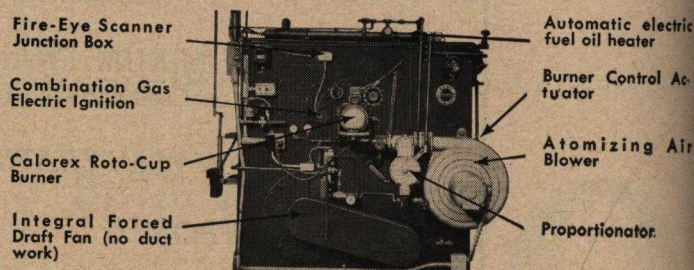
Line installation of Calorex Planned-Packaged Burners.

OTHER **BEST** PRODUCTS

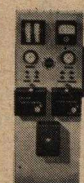
- Calorex Oil and Gas Burners.
- Calorex Rotary Cup Forced Draft Burners.
- Calorex Steam Atomizing Forced Draft Burners.
- Calorex Steam Atomizing Natural Draft Burners... Conical or Flat Flame Patterns... Register or Refractory Checker Work Type Firing.
- Calorex Stationary Tip Low-Pressure Air Atomizing Burner.
- Refinery By-Product Firing Equipment.
- Complete Fuel Oil Pumping and Heating Units...All Steam...Combination Steam and Electric or All Electric.
- Auxiliary Equipment for Oil and Gas Firing Burners.

Write for literature, or tell us about your specific requirements. Our engineers will have detailed recommendations in your hands promptly.

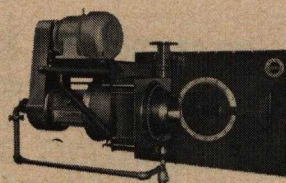
Calorex Forced Draft Boiler Front installation, with Best integral forced draft fan provides for either gas or oil firing. One step changeover adapts unit for either fuel.



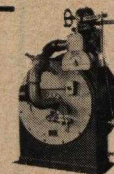
Calorex combination steam-electric fuel heating and pumping unit.



A single conduit connects this free-standing Calorex Cabinetrol to combustion system. It contains the latest electronic advances for automatic combustion control.



Calorex Roto-Cup Air Atomizing acid sludge firing unit. Available in capacities from 100 G.P.H. to 7,000 G.P.H.



Calorex Planned Package fully automatic gas fired units available 4,000 lbs. of steam and up. On oil fired units changeover to gas is accomplished simply by one step changeover involving interchanging atomizing unit with Calorex gas jet.

BINKS MANUFACTURING COMPANY

3128-36 CARROLL AVENUE, CHICAGO 12, ILL.

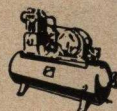
REPRESENTATIVES IN PRINCIPAL U.S. & CANADIAN CITIES



FREE INSTRUCTION



SPRAY BOOTHS



COMPRESSORS



FLUID TANKS



NATIONWIDE SERVICE

PRODUCTS AND SERVICES

The Binks line of ceramic finishing equipment is complete in every detail. It includes spray guns, fluid tanks, dry and water wash spray booths, automatic finishing machines, accessories . . . everything that's needed down to the smallest coupling. And, by standardizing on Binks you benefit from one source responsibility for all your ceramic finishing equipment.

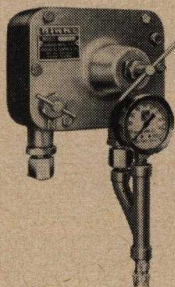
Binks engineers and customer service facilities are ready to help you improve an existing ceramic finishing system or set up a completely new and modern finishing operation . . . no matter where your plant is located.

Binks also conducts a spray finishing school which is open to all and covers all phases of ceramic finishing. No tuition is charged.

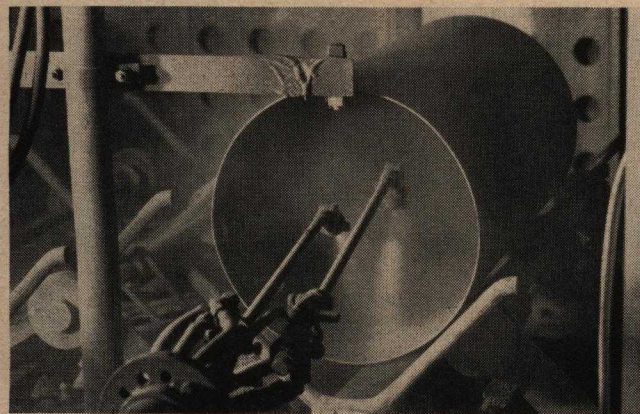
BINKS PM-120 REGULATOR FOR CERAMIC CIRCULATING SYSTEMS

The advantages of Binks circulating systems for ceramics are many. They permit laboratory exactness of centralized mixing. They eliminate fluid contamination. All stations apply identical finishes. Central mixing and storage reduce handling and increase plant cleanliness and safety.

Binks PM-120 ceramic regulator is the key unit which permits the application of circulating systems to ceramic finishing. Placed at each spraying station on the circulating system, the PM-120 accurately controls the flow and fluid pressure of porcelain enamels and ceramic glazes for that station.



BINKS AUTOMATIC MACHINES FOR CERAMIC FINISHING



Where it is desirable that ceramic finishing operations be continuous, Binks automatic spraying machines permit the establishment of a steady production tempo and reduce operating costs. Binks automatic spraying machines can finish virtually any product shape . . . flat, round, cylindrical or many sided. Automatic machines, such as the one shown above, applying a coating to the inside of a tank, are the result of Binks long experience with the problems and requirements of the industry. In co-operation with your personnel, Binks engineers will gladly survey your finishing department, make specific recommendations and demonstrate through pilot laboratory runs the results and economies you can expect.

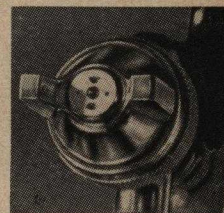
SEND NOW FOR CATALOG-DATA BOOK No. 956. A special index makes it easier to find the right unit from Binks complete line of equipment for ceramic and organic finishing. No obligation.



BINKS AIR NOZZLES FOR CERAMIC FINISHING

Binks air nozzles achieve excellent atomization—even at air pressures as low as 30 lbs. A reduction in the number of air orifices, an increase in orifice diameters and a complete rearrangement of orifice locations permits production spraying for full shifts without interruption for cleaning maintenance.

The controllable spray pattern of Binks air nozzles gives better coverage with fewer passes. A wide range of nozzles are available to permit the adaptation of spray guns to various finishes, air pressures and production rates.



BINKS MODEL 18VSS GUN FOR CERAMIC FINISHING

Patterned after the famous Binks Model 18 spray gun, the 18VSS is equipped with a stainless steel head, nozzle, fluid needle valve . . . all parts that come in contact with ceramic fluids. Stainless steel at these important points adds service life to the gun. It prevents corrosion of gun parts and metallic contamination of the sprayed fluids. Tungsten carbide inserts in the material nozzle and on the needle valve protect these vital parts against the abrasive action of vitreous materials. The Model 18VSS has a drop forged aluminum body with a tough black electrolytic finish.

Air nozzle is drop forged bronze, heavily plated. The air valve is an efficient cartridge type.



BINKS MODEL 31V FLOW GUN FOR CERAMIC FINISHING

Flows material on under hydraulic pressure. Nozzles for $\frac{1}{4}$ " to 2" flow. Parts in contact with material resist wear and are non-corrosive. New design replaces cupping.



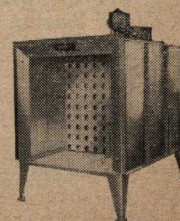
BINKS STAINLESS STEEL FLUID TANKS FOR CERAMIC FINISHES

All stop cocks, inside fittings, tubes, agitators and inner containers of Binks fluid pressure tanks for ceramic finishes are of corrosion-resistant stainless steel. This use of stainless steel for all parts which come in contact with ceramic materials prevents both corrosion of the parts and fluid contamination. Available in 5-, 10-, 15-, 30- and 60-gallon capacities, with or without agitators.



BINKS SPRAY BOOTHS FOR CERAMIC FINISHING

Binks manufactures a complete line of dry and water wash spray booths for either manual or automatic ceramic finishing. Scientifically baffled exhaust systems remove overspray and reclaim the frit. Available in either stainless steel or galvanized construction. All booths are designed for easy cleaning and maintenance.



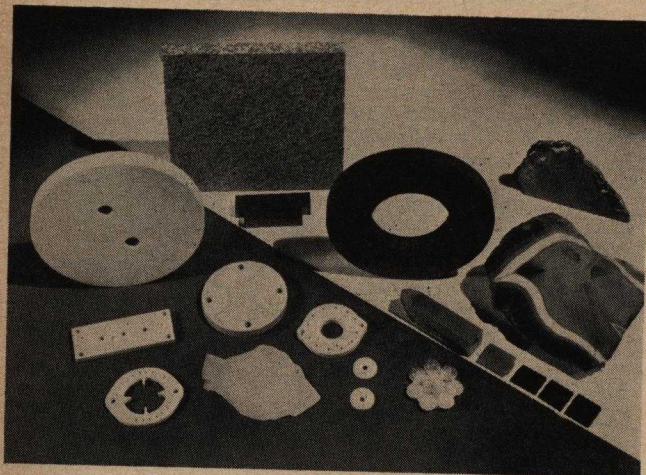
THE BLANCHARD MACHINE COMPANY

64 State Street, Cambridge 39, Massachusetts

PUT IT ON THE

BLANCHARD

for economical production of flat surfaces
on glass, ceramic, stone, jewels, etc.

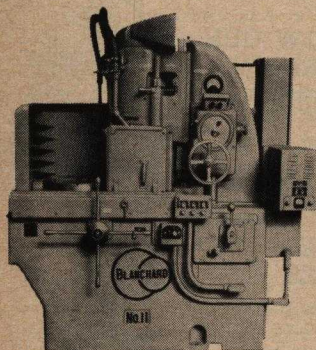


W-923

The Blanchard method of grinding flat surfaces has revolutionized the production of parts and products within the so-called "ceramic" industry. From the original grinding of optical glass prisms, Blanchard has progressed far in the pro-

duction of flat surfaces with extremely fine finish on all types of non-metallic materials. Finishes of 2 micro-inches and flatness within 1 band of light are almost a common occurrence with a Blanchard; in fact, subsequent operations such as lapping and polishing are often eliminated. Blanchard service includes free grinding of your work samples, and submission of reliable production data.

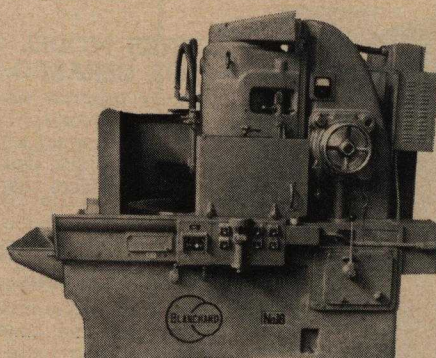
Many details on grinding techniques, together with descriptions of actual production jobs, are available in the booklets, "Work Done on the Blanchard," and "The Art of Blanchard Surface Grinding," both of which are free on request.



V-511

BLANCHARD No. 11

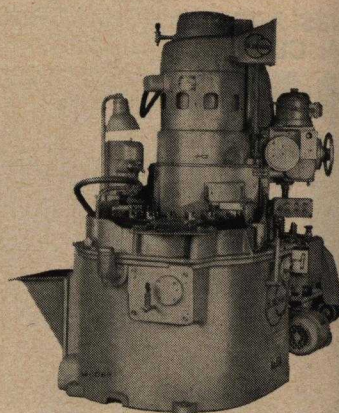
The smallest Blanchard Grinder is an extremely rigid machine. It features a large diameter grinding wheel spindle, direct motor driven, one piece steel magnetic chuck, and standard three-point adjustment of column and head. It has rapid power raising and lowering of wheel head, push-button control on feed gear box interlocked with feed, push-button controls are provided for wheel, chuck rotation and coolant pump. Feed is exceptionally sensitive which makes it capable of accuracy to "tenths" and surface finish to "millionths".



V-490

BLANCHARD No. 18

Used widely for both production and small lot work. Grinds rapidly from the rough, and produces finely finished surfaces of close accuracy and flatness. Individual motors power the various motions and are controlled with push buttons. Except for handling the work pieces, the operation is almost effortless. The steel magnetic chuck body is one piece. Three-point adjustment of column makes it easy to maintain accurate alignment or to incline the spindle for concave or convex grinding. A caliper attachment can be provided to measure the work without interrupting grinding.

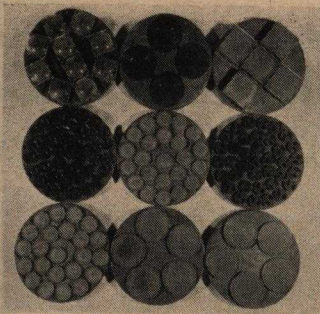


W-1089

BLANCHARD No. 16-A

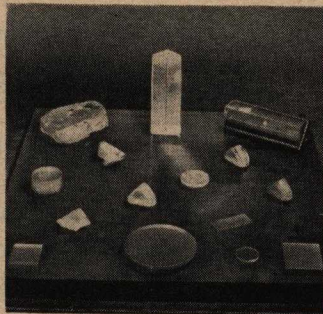
The #16-A Blanchard Automatic Grinder is used for quantity production of small parts. It grinds continuously with a wheel that is set and automatically maintained at a fixed height and grinds one surface of work to size in one pass under the wheel. The operator loads work pieces in suitable blocking or automatic clamping fixtures, designed by Blanchard. Depending upon work pieces, unloading can either be by hand or automatic.

BLANCHARD SURFACE GRINDERS



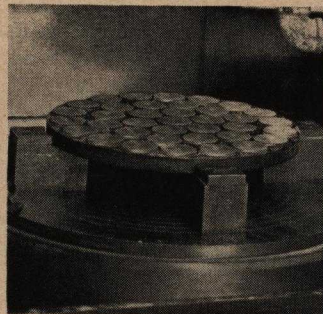
W-854

Typical groups of glass production parts. These are all ground on the No. 11 grinder.



W-845

Quartz crystal, prisms, reticle blanks, etc., ground on the No. 11.



W-850

Convex lenses, ground on No. 11. In two minutes grinding time, 1.5 mm. of glass is removed from each lens without edge chipping.



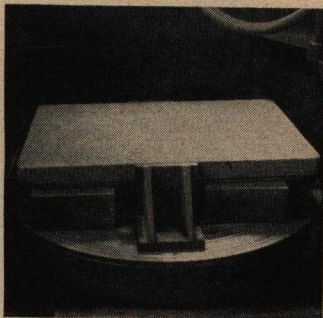
W-852

This Blanchard No. 11 is grinding 1100 small dove prisms in 15 minutes. Six mm. of glass is removed.



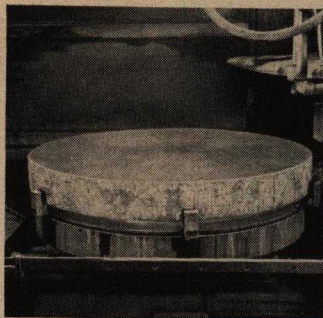
W-865

With this method of grinding quartz wafers, a production of 800 to 1000 wafers is obtained, per hour.



W-1147

This is an 18" x 36" granite surface plate which has been reconditioned on a No. 18. It is ground flat within .0002" after removing $\frac{1}{16}$ " of stock in 5 hours.



W-1010

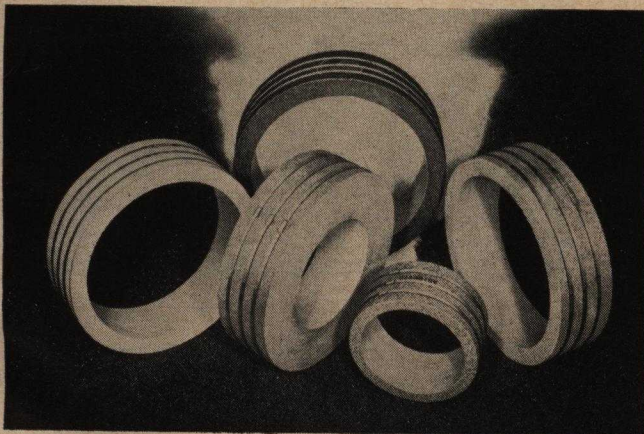
This 36" diameter Pyrex mirror was ground on a No. 18. Two sides were ground in 7 hours, removing a total of 638 cubic inches of glass.



W-1090

Ferrous ceramic transformer cores, similar to those shown above, are ground on the #16-A Grinder at rates as high as 2725 per hour. Stock removal .032".

BLANCHARD ABRASIVE WHEELS for fine finish, fast stock removal, low cost



V-495

Blanchard manufactures grinding wheels for use on all Blanchard grinders. As builders of the machines, Blanchard is best qualified to know wheel requirements. Wheels are made in cylinder, segment and sectored types. By selecting from a variety of vitrified, resinoid and silicate bonds and a number of different abrasives, Blanchard is able to make exactly the right wheel for every job. Occasionally diamond wheels are required, depending upon material.

THE BLANCHARD MACHINE COMPANY

64 State Street, Cambridge 39, Massachusetts

THE BONNOT COMPANY

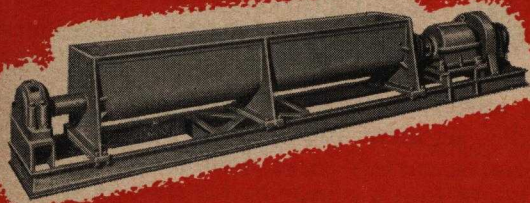
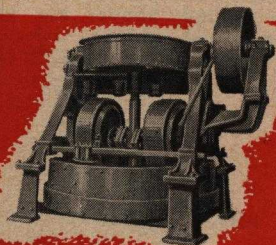
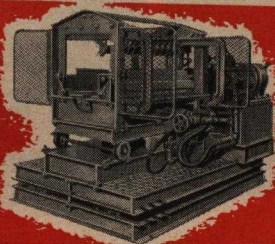
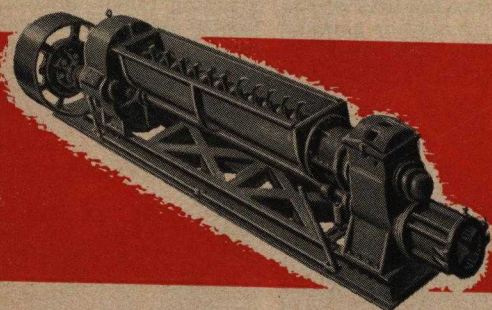
721 Mulberry Road SE

CANTON 2, OHIO

Cable: Bonnoco

BONNOT

Clay Working MACHINERY



BONNOT'S "Pre-engineered line" already includes

AUGER MACHINES
BALL MILLS
BRICK CUTTERS
BRICK SCRATCHERS
CLAY BLENDERS
CLAY FEEDERS
CLAY GRINDERS
CLAY MIXERS
COMBINED MACHINES
CRUSHERS
CUTTERS, MECHANICAL
CUTTERS, RECIPROCATING
CUTTERS, ROTARY
DE-AIRING, POTTERY
DE-AIRING, BRICK & TILE
DE-AIRING, REFRACTORIES

DE-AIRING, PIPE PRESS
DIES
DRY PANS
FEEDERS, DRY
FEEDERS, WET
GRANULATORS
HAMMER MILLS
MIXERS, DRY OR WET
PUG MILLS, HEAVY
PUG MILLS, POTTERS
PULVERIZERS
REPRESSES
ROTARY DRYERS
TILE CUTTERS
TUBE MILLS
WET PANS



- ★ HIGHEST QUALITY PRODUCTS
- ★ *insures* GREATEST COST CONTROL
- ★ SIMPLIFIED MAINTENANCE

"Integrity of performance" is built around "3 fundamentals which 75 years of experience prove are necessary for profitable clay processing." Continuous achievement of these fundamentals at Bonnot, is based on:

Experienced Engineering . . .

that begins with a positive analysis of your local conditions and needs by experienced Bonnot engineers. Your manufacturing—which differs from other plants in product and raw material—requires detailed study to insure equipment that unfailingly delivers to you—highest quality for highest profit . . . greatest cost control . . . minimum maintenance.

Superior Manufacturing . . .

that assures you year after year of uninterrupted production. Bonnot equipment is engineered for long wear . . . designed for simplification of maintenance with the advantage of interchangeable components. Quality wearing parts are produced in Bonnot's own foundry with NiHard and other iron alloys. When an emergency arises, you get the services of clay processing specialists.

Advanced Research . . .

in our lab and your plant—has perfected many "clay industry firsts" including production de-airing, frictionless bearings, front end absorption of thrust loads, off-center disc feeders, completely adjustable hydraulic cutters. These and other cost-saving advancements enable you to maintain delivery schedules and reasonable profit returns.

SEND US YOUR SPECIFIC REQUIREMENTS . . .

we'll do the rest . . . PROMPTLY!

The **BONNOT** Co.
CANTON 2, OHIO

BROOKVILLE LOCOMOTIVE WORKS

Gibson Blvd., Brookville, Pa., U.S.A.

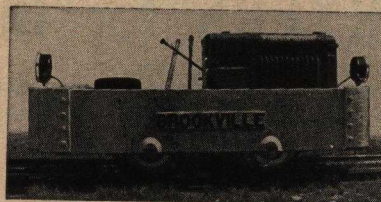
Power by Caterpillar, Ford or International Harvester

The high grade, heavy duty power plants employed in Brookville Locomotives are manufactured economically in quantity by the leading truck and tractor companies and readily serviced throughout the world.

The Right Model for the Job

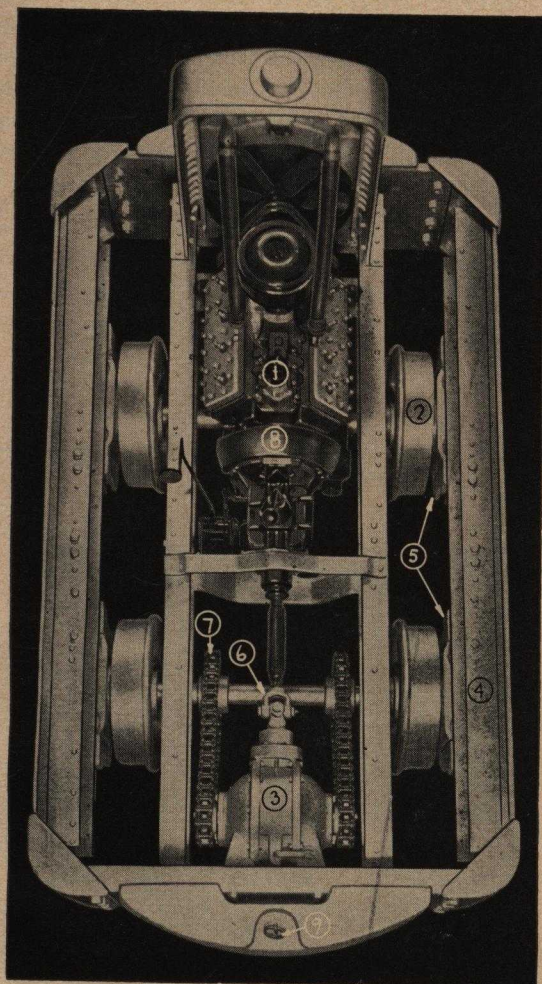
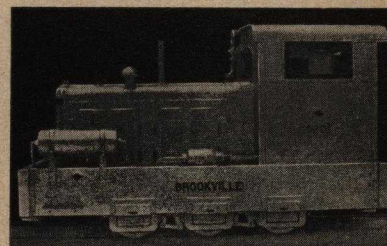
Eleven different weights available from 3 to 15 tons in size, with dimensions, gauges, couplers and speed range to suit requirements. Diesel or gasoline power. Standard and Low Mine types, with or without cab.

Send for catalog, specifying load, grade, and service.



1—Low Mine types can be built with overall clearance as low as 46" above rails. This unit is powered with an International engine.

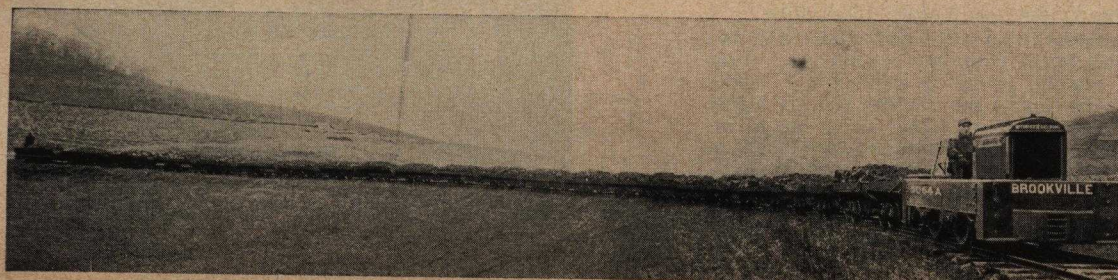
2—Enclosed cab on a 12-ton BROOKVILLE with 6-cylinder Caterpillar Diesel engine, Westinghouse air brakes and 6-wheel drive.



Overhead view of stripped chassis with Ford power.

BROOKVILLE FEATURES

- 1—*Standard engines.* Made by International Harvester, Caterpillar or Ford. Worldwide repair and replacement service. Wide range of sizes available permits plenty of power for each model.
- 2—*High traction steel wheels.* 25% higher traction than chilled face drivers.
- 3—*ALL-speed reverse.* Makes ALL four and five forward speeds also available in reverse.
- 4—*Indestructible steel frame.*
- 5—*Dual spring suspension.* Both cushions the load and allows for track irregularities.
- 6—*Double Universal joint.* Eliminates strain, easily disconnected for access to transmission or reverse.
- 7—*Oversize roller chain drive to ALL four wheels.*
- 8—*Heavy duty, multi-speed transmission.* Four and five speeds both forward and reverse.
- 9—*Rounded, semi-steel coupler castings.*
- 10—*Six months unconditional Guarantee on locomotive* against failure from any cause, including ordinary wear and excepting only accident or abuse. Engines carry the regular warranty of the engine manufacturer.



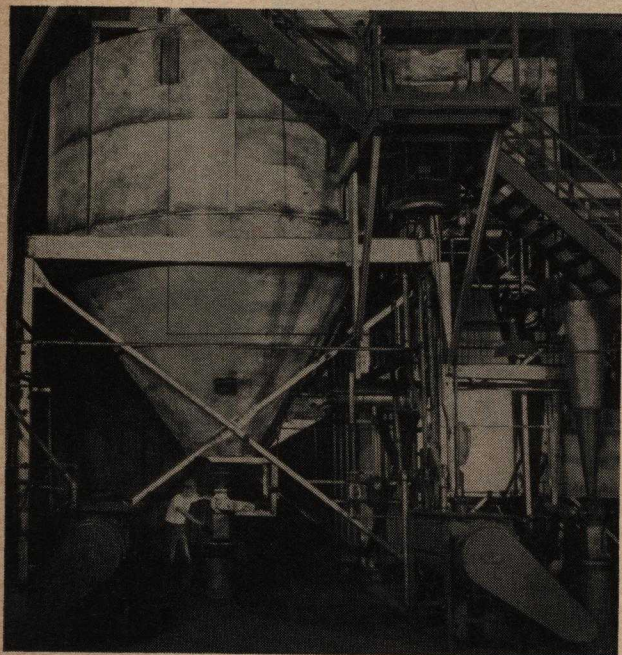
An 8-ton BROOKVILLE doing a 10-ton job. Hauling 24 cars, a total of 48 tons, up a 3½% grade around a curve.

BOWEN ENGINEERING, INC.

NORTH BRANCH 17, N. J.

SPRAY DRYERS for the CERAMIC INDUSTRY

The Bowen method for ceramic spray drying provides both improved operating conditions at lower operating costs and improved product quality with more precise control over product characteristics.



Stackpole Carbon Company has been operating this 16' diameter spray dryer with centrifugal atomization since 1950 as part of an improved process for the molding of their CERAMAG ferro magnetic cores. This was the first spray dryer to dry ferrites.

BOWEN PATENTED ABRASION RESISTANT ATOMIZING UNITS.

The atomizing unit is the heart of a ceramic spray dryer. It must be of special wear resistant construction and design because of the highly abrasive nature of the feed material.

The choice of centrifugal or nozzle atomization depends on the type of material to be dried, the rate of production, the space available and the economic considerations. Bowen offers two types of ceramic spray dryer; one with centrifugal atomization and the other with nozzle atomization:

1. *Bowen Ceramic Spray Dryer with Centrifugal Atomization.*

The Bowen Ceramic Spray Dryer employing centrifugal atomization is of co-current design with a conical drying chamber. The chamber is especially designed with a maximum diameter for greater flexibility in the production of free-flowing particles. The primary product discharge is at the base of the drying chamber.

The Bowen abrasion resistant centrifugal atomizer is driven by a Bowen high speed spray machine ruggedly built for heavy 24-hour duty.

2. *Bowen Ceramic Spray Dryer with Nozzle Atomization.*

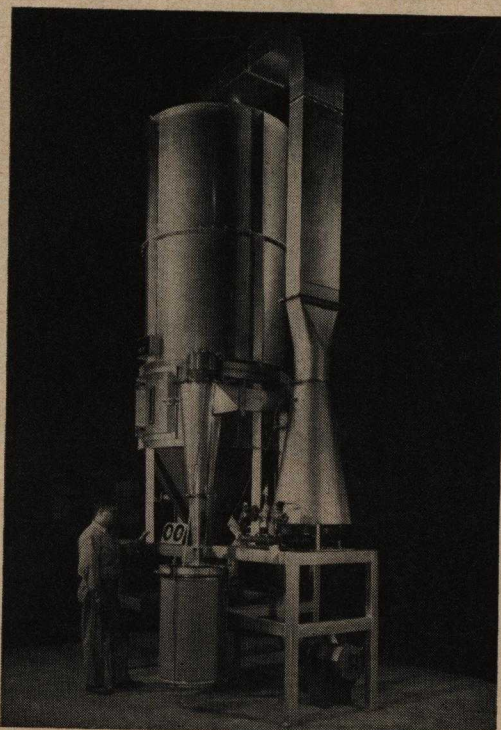
The Bowen Ceramic Spray Dryer with nozzle atomization has found wide acceptance in the electronic ceramic field. Free flowing particles of titanate, ferrite or alumina with binder are discharged from the base of the chamber and are highly satisfactory for molding operations. The nozzle can be installed at the top of the chamber for co-current operation or at the base of the chamber for simulated counter-current operation.

This Bowen Ceramics Spray Dryer with nozzle atomization has been highly popular because of the present demand for a reasonably priced compact unit in the Ceramic field having a low operating cost.

During 1958 Bowen acquired the business and assets of Instant Drying Corporation. Reference herein to Bowen includes the comprehensive facilities and services of the combined companies.

The Bowen method of ceramic spray drying is a preferred process for ceramic slip because it is a continuous operation eliminating handling involved in batch operations. It can be integrated into the overall process to eliminate many prior and subsequent steps such as filtering, decanting, preforming, tray drying, pulverizing, grinding, screening and classifying.

Bowen spray dryer installations in the ceramic and clay industry now totalling (33) thirty-three include kaolin paper coating clays, abrasives, electronic ceramics such as steatites, titanates and aluminas, china clays, ceramic colors and ceramic tile.



This 4 1/2 foot diameter Bowen ceramic spray dryer is specifically designed for the production of ceramic bodies suitable for dry pressing and incorporates nozzle atomization.

The Advantages of the Bowen Method of Spray Drying

1. Improved product quality with more precise control over product characteristics:

(A) CONTROL OF PARTICLE SIZE AND BULK DENSITY

The mechanical properties that affect the outcome of a dry pressing operation, and that can be controlled readily by spray drying, are average particle size, particle size distribution, bulk density, final moisture content and flowability.

(B) UNIFORM, PRECISE CONTROL OVER FINAL MOISTURE CONTENT

In a Bowen Spray Dryer installation final moisture can be maintained within limits of $\pm\frac{1}{2}\%$ or less at values from 1% to 10% final moisture. The exact final moisture of the body will affect its bulk density, its tendency to agglomerate and its flowability.

(C) FREE FLOWING CHARACTERISTICS

Better pressing results are obtained as the range of particle sizes narrows. Some of the operating conditions which can be controlled to improve the quality of the product include:

- a. Solids concentration. If small particles are to be avoided, the weight percent solids in the feed slip should be as high as possible.
- b. Binder. The dried particle is formed as an agglomerate of the discrete particles in the slurry, the type and amount of binder included in the slip will control the agglomeration in the drying phase, and will have an effect on the agglomerated particles' resistance to attrition in later handling.
- c. Atomization. In general, larger agglomerates are produced with lower rotational speeds in the case of centrifugal atomizers and with lower nozzle pressures in the case of nozzle atomizers.

(D) HOMOGENEITY AND UNIFORMITY

In the manufacturing of small electronic ceramic parts, either by pressing or extruding, the precise proportions of the blending constituents must be carried through to the smallest finished part if the required dielectric tolerances are to be met. When the constituents have been milled to a fine particle size and thoroughly blended and are then spray dried from a well-dispersed slurry, it is possible to carry this homogeneity and uniformity through the agglomerated dried particle.

(E) FREEDOM FROM CONTAMINANTS

Where a spray dryer has been integrated into a production line, it is much easier to avoid introduction of contaminants and foreign substances. Spray drying will pay dividends in many applications such as ceramic colors and pigments, or wherever very small quantities of impurities will have an adverse effect on the finished product.

(F) DRY PRODUCT HAS GREAT DEAL OF REDISPERSIBILITY

Material that has been spray dried from a well-dispersed slurry usually consists of a characteristic spherical, free-flowing agglomerate of the discrete particles having a very low angle of repose. It is felt that this characteristic shape contributes to the ability of the dried material to redisperse rapidly. A typical case is the spray drying of kaolin clays used for paper coating.

2. Improved operating conditions at lower operating costs:

(A) CONTINUOUS OPERATION

The spray drying installation lends itself readily to continuous automatic operation over 24-hour periods. Operating costs are improved tremendously over batch methods.

(B) MINIMUM LABOR

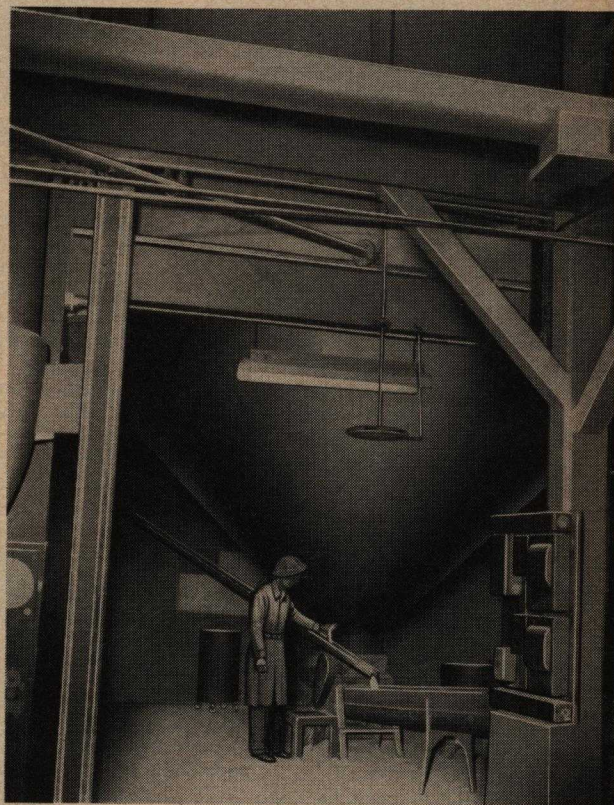
A spray dryer can be built for practically any production rate without a proportionate increase in operating labor.

(C) REDUCED OVERHEAD

A spray dryer properly integrated in the process can replace many other operations.

(D) LOW MAINTENANCE

A single spray dryer built for high capacities has a minimum of moving parts. Maintenance costs are low.



Spray Dryer (Instant Drying) at Gladding, McBean for tile clays permits fine screening of the body, elimination of spot forming contaminants and more thorough mixing of body constituents.

The advantages due to the use of spray drying can usually be estimated quite accurately after a minimum of tests at the Bowen Laboratory, and can be expressed in lower costs per ton of product as compared to alternate processing methods.



BOWEN ENGINEERING, INC.

Recognized Leader in Spray Dryer
Engineering Since 1926

NORTH BRANCH 17, NEW JERSEY

THE CAMBRIDGE WIRE CLOTH CO.

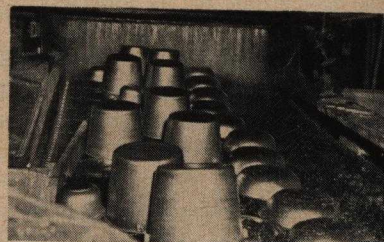
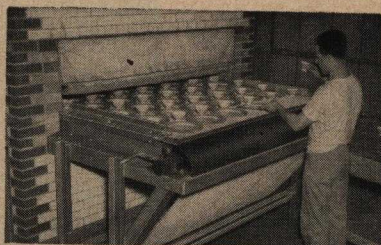
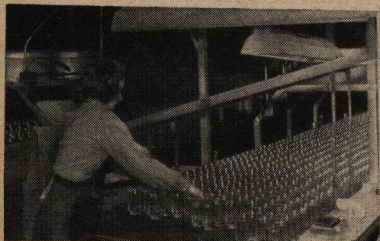
DEPARTMENT S • CAMBRIDGE 11, MARYLAND

OFFICES IN PRINCIPAL CITIES

CAMBRIDGE WOVEN WIRE CONVEYOR BELTS take the Bottlenecks out of CERAMIC PRODUCTION

By combining controlled movement with free circulation of heat and rapid drainage of process solutions, Cambridge belts provide uniform firing and annealing, fast washing, draining and drying while

work moves through your plant. Continuous, belt-to-belt flow cuts costs by eliminating batch handling and providing uninterrupted production without need for cars or kiln furniture.



GLASSWARE

After raw materials are mixed, melted and formed—either by hand or machine—woven wire FEEDER BELTS carry the ware from molding stations to the annealing lehr directly, without trays or racks. All-metal belts can be preheated before receiving hot ware to prevent checking. Flame tunnels can be installed after the last loading point to assure maintenance of even temperature. Ware rides through the ANNEALING LEHR on open mesh belt . . . heat circulates freely, assuring uniform temperatures throughout the chamber. Continuous movement on belts carries ware past INSPECTION stations. DECORATING is speeded as ware moves to and from these stations in a continuous stream without need for hand dollies or carts. Ware is handled with same uniform results on belts moving through DECORATING LEHRs. Even CULLET can be more efficiently removed to crushers on woven wire belts which are not damaged by bits of broken glass.

WHITEWARE

From the time individual pieces are first formed from pug, the entire production line can be conveyorized. On woven wire belts DRYING proceeds faster and more uniformly. Time is saved in SAND BLASTING as open mesh assures positive drainage of particles. BISQUE INSPECTION is continuous. Underglaze DECORATING with decals is speeded as belts carry ware through rinse water to remove transfer paper. High temperature belts eliminate racking as they convey ware through HARDENING-ON kilns at controlled speed. Free drainage of excess glaze through woven wire speeds GLAZING operation. Saggers are eliminated and handling is greatly reduced in GLOST KILNS. The moving belt permits faster firing at closely controlled temperatures after OVER-GLAZE DECORATING. The need for kiln furniture is eliminated and results are more uniform.

PORCELAIN ENAMEL

Woven wire belts reduce maintenance and speed production in porcelain enameling plants, even before the enamel is applied. BETWEEN DRAWS abrasion resistant belts convey ware from one press to the next. Open mesh construction eliminates clogging and caking of drawing compound on the belt. Ware moving down the belt in continuous stream is removed for SPINNING, BEADING and CURLING, and replaced on the same belt to be conveyed to subsequent operations. WASHING, CLEANING, and DRYING can be performed on a single woven wire belt. Hot water rinse to remove drawing compound proceeds rapidly as open mesh permits fast drainage. ALKALI or ACID baths do not attack corrosion resistant belts. Subsequent rinses and neutralizing steps are equally simple on woven wire belts and free circulation of hot air all around the ware speeds drying. Conveyor to GROUND COAT prevents contamination of ware, as dirt and other foreign matter do not stick to the smooth all-metal belt.



Belt manual includes data on conveyor and conveyor belt design, metallurgical tables and belt maintenance hints. Folders describe specific applications for woven wire conveyor belts in pottery plants and glass plants. Write for your copies today. Please specify which you want.

"6 Ways to Reduce Maintenance and Speed Production in PORCELAIN ENAMEL PLANTS"

"9 Ways to Speed GLASSWARE PRODUCTION"

"13 Ways to Speed CONTINUOUS POTTERY PRODUCTION"

Ask, too, for your copy of 130-PAGE REFERENCE MANUAL giving mesh specifications, design information and metallurgical data.



The Cambridge Wire Cloth Co.

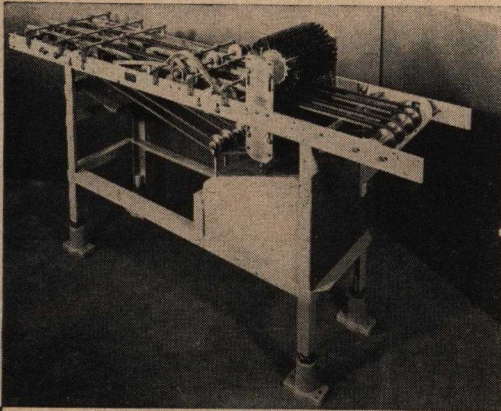
Dept. S • Cambridge 11, Md.



OFFICES IN PRINCIPAL INDUSTRIAL CITIES

CAMMERZELL TOOL AND DIE WORKS INC.

650 STRAWBERRY ST.
TRENTON 8, NEW JERSEY



FETTLING MACHINE

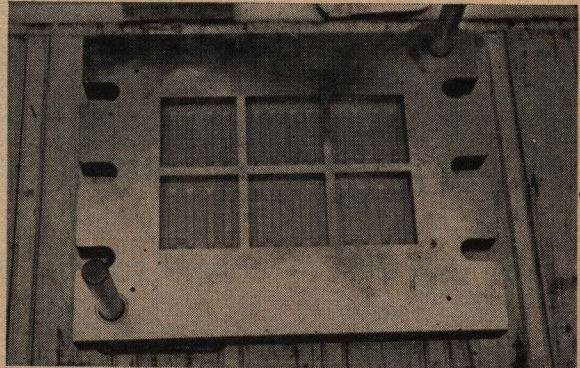
(Tile Trimming Machine)

A rigidly built machine designed to the customers' specifications. It can be adapted for use on tile of various sizes and to handle pieces from 2, 4, 6, or other impression dies. This machine may be used in conjunction with any type tile press.

To insure maximum tile cleanliness, the pieces are conveyed on V-belts and are brushed top and bottom with rotary Nylon brushes in one operation. Long wearing rotating grinding wheels that are easily adjusted remove the fin from the tiles.

Easy to lubricate sealed ball bearings are used throughout the machine and it is powered with a ratiomotor that can be plugged into any 110 volt outlet.

Fettle Machine can be converted to flip over tile. It can also be arranged to fettle the tiles face down.



TILE DIES

We Specialize in the Manufacture of Floor, Wall, and Trim Dies, of Any Size

These dies are made to the customers' specifications and can be made for any type of hand or power press. We recommend dies with liners and punches made of hardened and ground high-chrome high-carbon steel for maximum tile footage between die changes and minimum die costs.

To assure proper die alignment, to hold uniform clearances, and to cut setup time to a minimum, these dies can be made with through guide pins.

Let us quote you on your requirements. Our dies are known throughout the world.

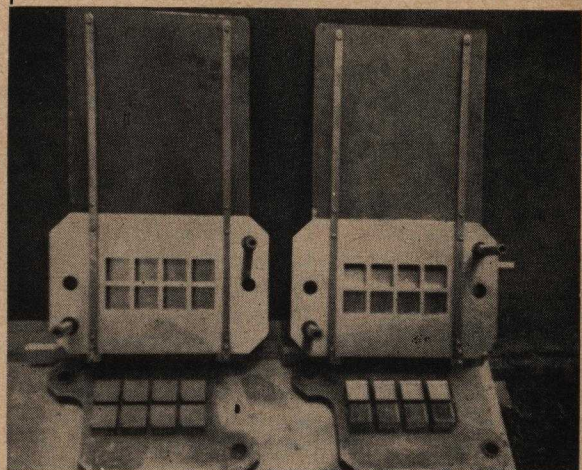
MOUNTING BOARDS

We manufacture mounting boards that can be made for any floor tile pattern that the customer wishes to make. The boards are cut to close tolerances to assure uniform mounting, and all spacer strips are held securely in place.

TILE SHAKER

The tile shaker is built for use with floor tile, to make the fired pieces free of sand. This machine sieves the sand and separates it into coarse and fine particles so that the fine may be reused. The tiles are also sorted and the pieces stuck together on firing are separated from the single or usable pieces. A variety of floor tile sizes may be made sand-free on the same shaker.

The machine is of rigid construction and designed to give a sliding motion to the tiles so that chipped pieces are held to a minimum. Sealed ball and roller bearings are used throughout the machine and it is powered with a rugged ratiomotor.



BOOKS

These books can be made so that floor tiles or small wall tile pieces of various sizes and shapes can be taken from dies with any number of cavities for stacking. They are well constructed for long life but light for easy operation.

CERAMIC COLOR AND CHEMICAL MFG. CO.

Specialists in Colors and Chemicals to the Ceramic Industry

New Brighton, Pennsylvania, U.S.A.



"Ceramic" can make prompt delivery on practically all colors and chemicals required by the ceramic industries. All "Ceramic" colors are tested under conditions simulating those in the cus-

tomers' plant. They are noted for uniformity on repeat orders, and for the high degree of fidelity with which original samples are matched.

ENAMEL COLORS

"Ceramic" makes a complete line of colors specifically adapted to meet the requirements of every branch of the porcelain enameling trade—for signs, architectural sheets, kitchenware, refrigerators, stoves and ranges, and sanitary ware, whether cast iron or sheet iron.

Color Oxides
Screening Colors
Screening Oils
High Temperature
Ceramic Coatings
Chalkboard Coatings
Decals
Graining Colors
Smelter Oxides

COLORS FOR GLASS

"Ceramic" offers a complete range in vitrifiable glass colors for glassware, either as a necessary utility feature, a decoration, or for permanent product identification.

Alkali and Acid Resisting
White Enamels
Weather-Resisting
Enamels
Satin-Matt Finish Colors
High Fire Convexing
Colors
Chalkboard Coatings
Low Fire Vitrifiable Colors
Fluxes
Ices
Transparent Colors

COLORS FOR POTTERY

"Ceramic" colors are made to meet conditions of modern pottery production and to fill the requirements of the finest ware for delicacy of tones, uniformity of color, and permanence of decorations.

Glaze Stains
Body or Engobe Stains
Underglaze Colors
Overglaze Colors
Glazes, Clear or Colored
Fritted Glazes and
Fluxes
Art Glazes
Hobbyist Supplies

COLORS FOR TILE

"Ceramic" colors, especially prepared for tiles and heavy clay products, are carried for prompt shipment in large quantities.

Glaze Stains
Body Stains
Fractionated Metallic
Oxides for Speckled
Glazes:
Nickel
Iron
Manganese
Colored Specks
Art Glazes

SPRAY EQUIPMENT

"Ceramic," as agents for the Paasche Airbrush Company, carries a complete stock of equipment and repair parts at New Brighton, Pa. for prompt shipment.

Spray Guns,
Manual and Automatic
Artists Airbrushes
Spray Machines,
Standard or Custom
Spray Booths
Pressure Tanks
A.S.M.E. Spec.

MILL ROOM AND LAB EQUIPMENT

"Ceramic" maintains a stock of both production and laboratory grinding equipment at New Brighton, to facilitate prompt shipment.

Grinding Balls
Porcelain
High Density
Lining Blocks
Porcelain
High Density
Porcelain Jar Mills
Laboratory and
Production
Porcelain Jars

DECORATING OILS AND EQUIPMENT

"Ceramic" can make prompt delivery of decorating supplies for hand and machine operation.

French Fat Oil
Oil of Copaiba
Balsam Copaiba
Balsam Fir
Screening Oils
Prepared Mediums
Decoration Brushes
Screening Cloth—
Silk, Stainless Steel,
and Nylon

CHEMICALS AND SUPPLIES

We carry a complete line of chemicals and raw materials at our warehouse in New Brighton, Pa. Shipment of orders is normally made the same day the order is received.

Aluminum Hydrate
Aluminum Oxide
Ammonium Carbonate
Ammonium Metavanadate
Antimony Oxide
Antimony Sulphide
Arsenic Oxide
Barium Carbonate
Barium Chromate
Barium Molybdate
Bentonite
Beryl
Black Needle Antimony
Bone Ash
Borax
Boric Acid
Cadmium Carbonate
Cadmium Oxide
Cadmium Sulphide
Calcium Carbonate
Cerium Hydrate
Chromium Oxide, Green
Clay, Enameler's
Cobalt Carbonate
Cobalt Oxide
Cobalt Sulphate
Copper Carbonate

Copper Oxide
Cryolite
Dolomite
Epsom Salts
Gum Arabic and Tragacanth
Iron Chromate
Iron Chromite
Iron Oxide, Granular
Iron Oxides, Red and Black
Lead Bisilicate
Lithium Carbonate
Lithium Metasilicate
Magnesium Carbonate
Manganese Carbonate
Manganese Dioxide
Manganese Phosphate
Molybdenum Oxide
Nepheline Syenite
Nickel Carbonate
Nickel Oxide, Granular
Nickel Oxide, Gray and
Black
Nickel Salts, Double
Nickel Salts, Single
Opax
Potassium Bichromate
Potassium Carbonate

Potassium Silico Fluoride
Powder Blue
Pyrophyllite
Rutile
Selenium
Soda Ash
Sodium Antimonate
Sodium Bichromate
Sodium Fluoride
Sodium Nitrate
Sodium Nitrite
Sodium Silicate, Powdered
and Syrup
Sodium Silico Fluoride
Superpax
Talc
Tin Oxide
Titanium Dioxide
Vanadium Oxide
Whiting
Zinc Oxide
Zircon, Granular and Milled
Zirconium Oxide
Zirconium Silicate
Zircopax

GODFREY L. CABOT, INC.

MINERALS & CHEMICALS DIVISION 77 Franklin St., Boston 10, Mass.

You can STOP

- CRACKING
- DUNTING
- CRAZING
- BREAKAGE
- GLAZE DEFECTS

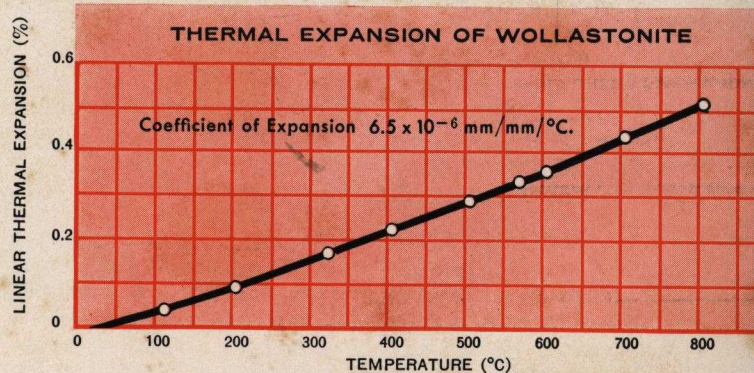
with WOLLASTONITE

CALCIUM METASILICATE

Brilliant white, Wollastonite has outstanding uniformity, is a natural calcium silicate, acicular in particle shape and available in large reserves. Wollastonite is recommended for wall tile · glazed, porous ceramics of nearly every kind · dinnerware · ovenware · artware · glazed ceramic structural clay products · terra cotta · sanitaryware · chemical stoneware · ceramic bonded abrasives · ceramic bonded refractories · high alumina bodies · spark plugs · low-loss ceramics · other electrical porcelains · frits and investment castings.

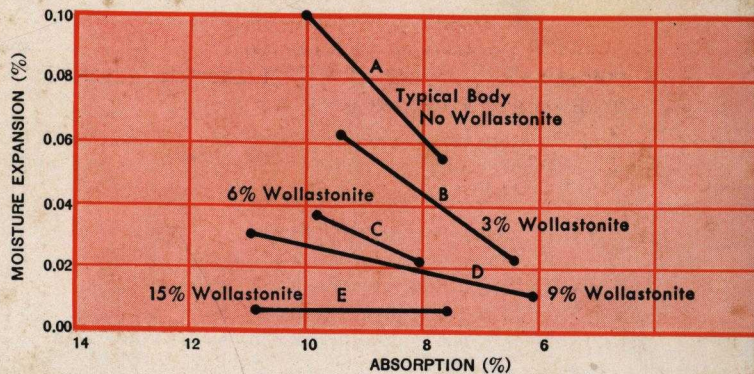
STOP CRACKING AND DUNTING GET IMPROVED HEAT SHOCK RESISTANCE

The low straight line thermal expansion of Wollastonite, as shown to the right, permits faster firing and greater resistance to cracking resulting from heat shock. In certain bodies it has been found to decrease the severity of the silica inversion. For example, a typical case is that of an artware manufacturer who found that 3% Wollastonite substantially reduced losses from cracking and dunting. Wollastonite can also improve the thermal shock resistance of your product.



ELIMINATES MAJOR CAUSE OF DELAYED CRAZING LOW MOISTURE EXPANSION

Wollastonite itself has virtually no moisture expansion and therefore even at extremely low concentrations has effectively reduced moisture expansion of all types of ceramic bodies. A large producer of glazed ceramic structural clay products was amazed at how low amounts of Wollastonite eliminated crazing . . . previously resulting from moisture expansion. Note the effectiveness of Wollastonite in a dinnerware composition as shown to right. Wollastonite makes glazed ceramic products look better and last longer, for longer periods of time. Products keep that "new look" with Wollastonite.



Effect of Wollastonite on moisture expansion when substituted for flint in a typical dinnerware body.

PROPERTIES OF WOLLASTONITE

Chemical Formula	CaSiO ₃
Crystalline Structure	Acicular
Coefficient of Expansion (100% Wollastonite) (mm/mm°C.)	6.5 x 10 ⁻⁶
Molecular Weight	116
pH (10% Slurry)	9.9
Specific Gravity	2.9
Hardness (Mohs Scale)	4.5
Inverts to PseudoWollastonite (°C.)	1200
Melting Point (°C.)	1540
Solubility in H ₂ O (gm/100cc)	.0095

CHEMICAL ANALYSIS

SiO ₂	50.90%
CaO	46.90
FeO	.55
Al ₂ O ₃	.25
MnO	.10
MgO	.10
TiO ₂	.05
Loss on Ignition	.90
	99.75%

Cabot ceramic technical and sales engineers are available at all times to answer questions . . . to help you to find the correct Wollastonite grade best suited to your own operation. Won't you choose from those listed the one in which you are most interested . . . and let us help you to put it to work making better ceramics for you.

GODFREY L. CABOT, INC.

MINERALS & CHEMICALS DIVISION 77 Franklin St., Boston 10, Mass.

Save money and improve ceramics with **WOLLASTONITE**

✓ **REDUCED DRYING and FIRING SHRINKAGES**

The high purity and acicularity of Wollastonite contribute to a notable reduction of unwanted drying and firing shrinkages. Wall tile bodies containing 55% and more of Wollastonite have shown a firing shrinkage as low as 0.1 to 0.2% and this size stability has remained over the range of cone 04 to cone 01.

✓ **FASTER FIRING**

Faster firing is possible with Wollastonite because of both its low straight line coefficient of expansion and its absence of water of hydration. High Wollastonite wall tile bodies can be safely fired in as few as forty minutes. With faster firing there is of course a greater yield from kiln investment. Even at fast firing rates, there is less cracking and dunting and therefore a higher yield of first quality product.

✓ **AUXILIARY FLUX**

As an auxiliary flux Wollastonite can be used in the range of 1-7% of the batch to accommodate changes in composition or/and processing, as for example, firing temperature. It may also be used to reduce porosity or increase strength at the same firing temperature.

✓ **EASY PRESSING**

The fibrous structure of Wollastonite results in easier pressing ... stops lamination and gives good die fill ... increases the production rates of dry-pressed ware. Tile manufacturers are particularly pleased with the advantages which Wollastonite makes possible in this respect.

✓ **GLAZES**

Wollastonite is ideal in glazes ... it is a naturally fritted source of lime and silica, due to its low ignition loss. It may thus be used as a total source of lime, to give brighter, smoother glazes. Wollastonite is widely used for this purpose by manufacturers of sanitaryware, tile, porcelain enamel frits and the like. Many are also finding Wollastonite particularly advantageous in producing high calcium matte glazes.

✓ **HIGHER FIRED STRENGTH**

Ceramic bodies made with Wollastonite are stronger. As greater amounts of Wollastonite are added, marked improvement is noted in impact and transverse strength, and often in compressive strength as well.

✓ **BOND for REFRACTORIES and ABRASIVES**

Wollastonite gives less distortion with better bonding. This is due to the low ignition loss which permits more intimate contact of bonding materials in abrasives and refractories. Where it is used as a bond for SiC refractories, there is reduced oxidation of SiC crystals below cone 8-9.

✓ **IMPARTS GOOD ELECTRICAL PROPERTIES**

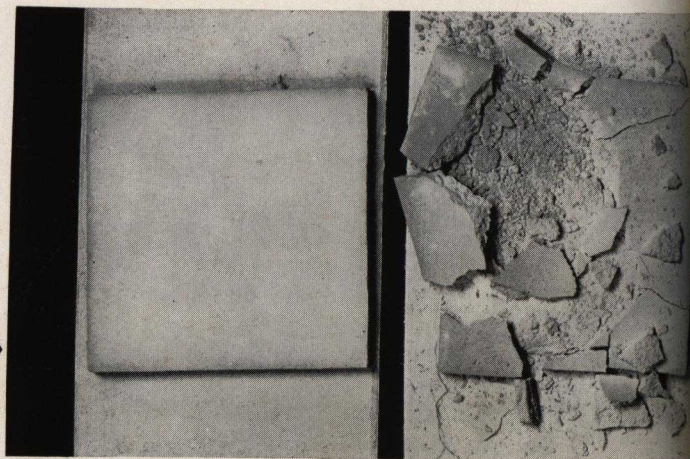
Wollastonite imparts good electrical properties to ceramic bodies, due largely to the absence of alkalis in its composition. Superior Wollastonite low-loss bodies (Grade L-6) have already been developed. Considering these and others of the above properties, the usefulness of Wollastonite in other electrical ceramics appears most promising.

HOW TO SAVE MONEY WITH WOLLASTONITE

Formulations containing Wollastonite are more economical ... and at the same time bodies are improved ... glazes too! The fibrous structure and low ignition loss combine to give easy-forming, problem-free drying and firing in most bodies.

C-101 Sieve Analysis (100 mesh)	8.0%
C-6 Sieve Analysis (minus 325 mesh)	79.2%
C-1 Sieve Analysis (minus 325 mesh)	96.5%
P-1 Sieve Analysis (minus 325 mesh)	99.7%
P-4 Sieve Analysis (minus 325 mesh)	99.95%

Reduced drying problems with Wollastonite tile ... the 2 above tiles were prepared under identical conditions, with compositions differing only in the substitution of an equivalent amount of Wollastonite for Talc. Visual examination showed no pressing laminations and the tiles were placed immediately after pressing in a drier at 800°F. Wollastonite tile (left) dried rapidly and thoroughly, remained in excellent condition whereas tile made with Talc (right) disintegrated completely.



Free Samples Available from Your Nearest Cabot Agent or from



White Pigments Dept.,
MINERALS & CHEMICALS DIVISION

GODFREY L. CABOT, INC.

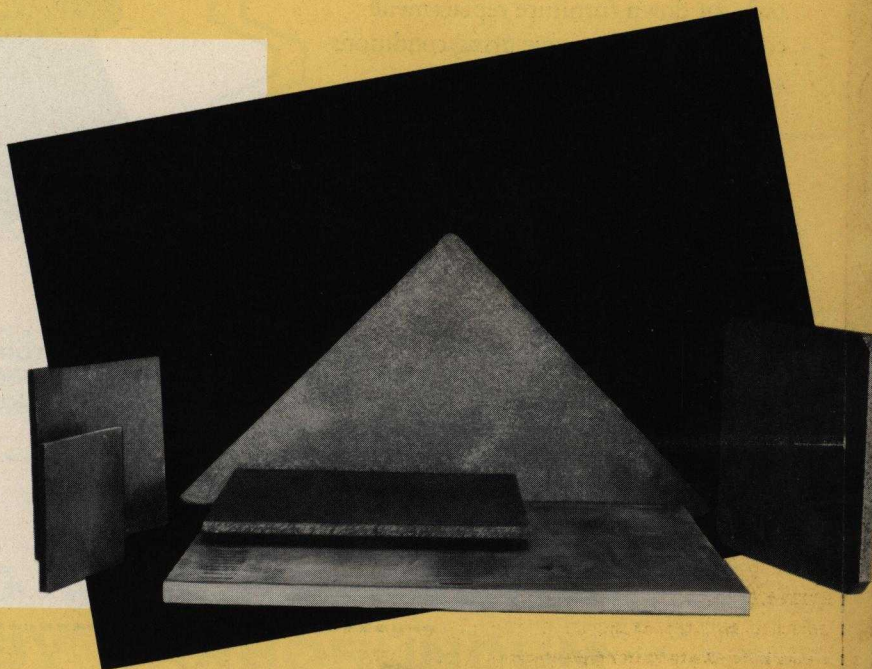
77 Franklin Street, Boston 10, Massachusetts

You'll find the shapes you need at **CARBORUNDUM**

TRADE MARK

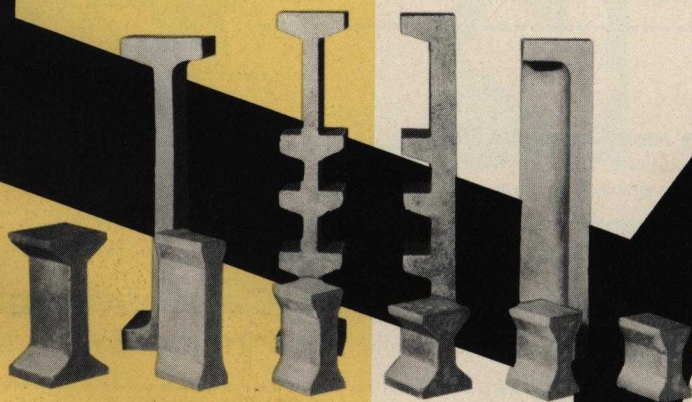
FOR TILE

Thinner, yet stronger and more durable, CARBOFRAX® silicon carbide tile stay flat and free from warpage. They withstand repeated handling, do not tend to grow, crack or blister. They carry heavy loads, stay clean . . . and keep the ware clean. Their high thermal conductivity also assures you of uniform ware burning.



FOR POSTS

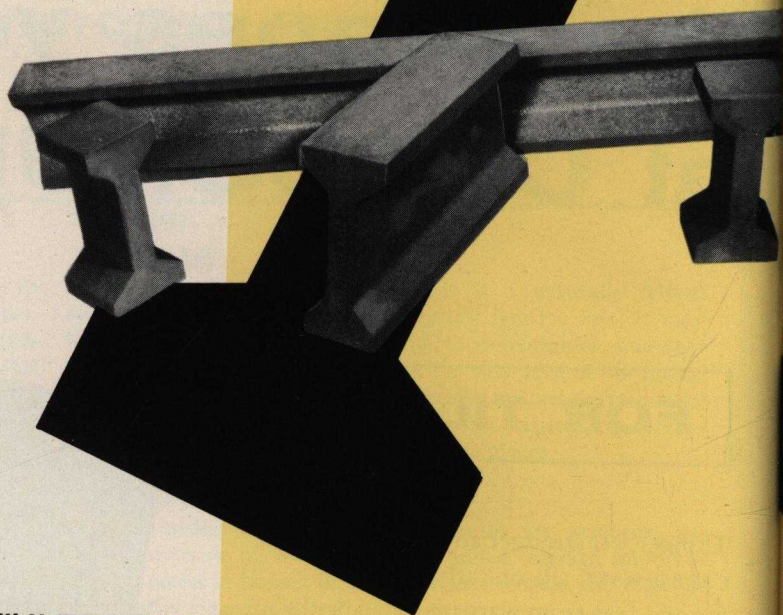
Since CARBOFRAX posts don't squat, they give tile better support. This means fewer rebuilds on permanent set cars . . . faster, easier rebuilds of tear-down settings, since posts hold dimensions in service. Their trim, space-saving shape makes loading easier . . . increases payload, decreases dead load.



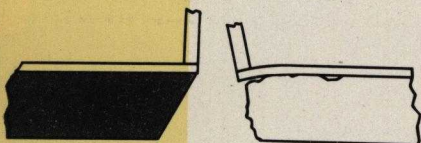
AND FOR . . .

GIRDERS

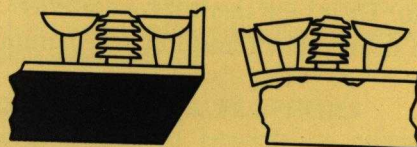
Need new furniture? Before you replace setter tile and posts, you should consider whether you can make them last longer. An investment in proper support will not only cut down furniture replacement costs—but will improve firing conditions as well. Here's why:



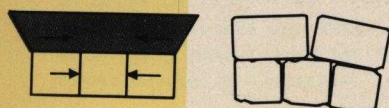
- 1 PROLONG KILN FURNITURE LIFE**
Setter tile don't bow, and cracking is minimized, because CARBOFRAX® girders don't warp, crack or end squat.



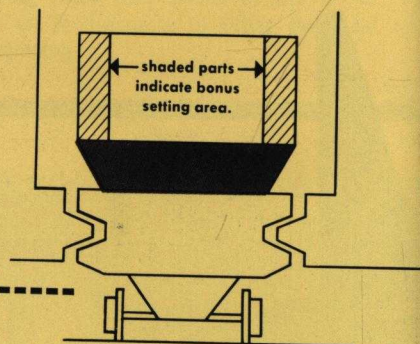
- 2 WARE IS UNDISTORTED**
because tile remain flat and level: they are evenly supported on a flat surface.



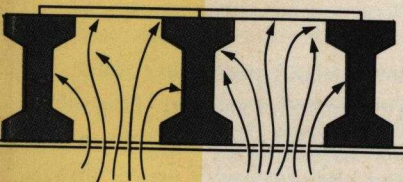
- 3 UNIFORM LOAD DISTRIBUTION**
One-piece construction holds the car-top blocks together, spreads load evenly over the car-top, and reduces car-top maintenance.



- 4 MORE WARE PER CAR:**
you use the full setting area, yet weight is distributed without stressing the overhang.



- 5 IMPROVED HEAT CIRCULATION**
and firing conditions. The ware heats more evenly from top of car to bottom.

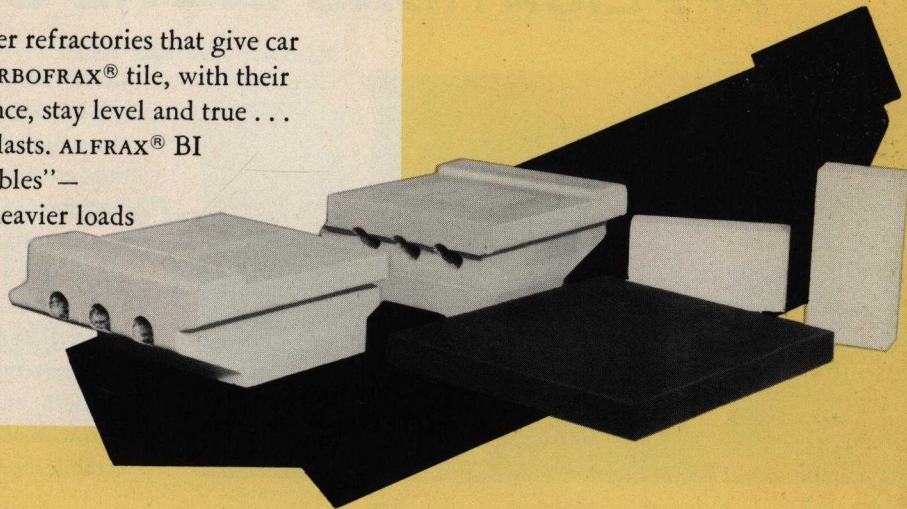


- 6 YOU BUILD SUPERSTRUCTURE FASTER**
because no time is wasted padding and levelling the deck tile and top of the girders.

**Carbofrax girders
hold their shape**

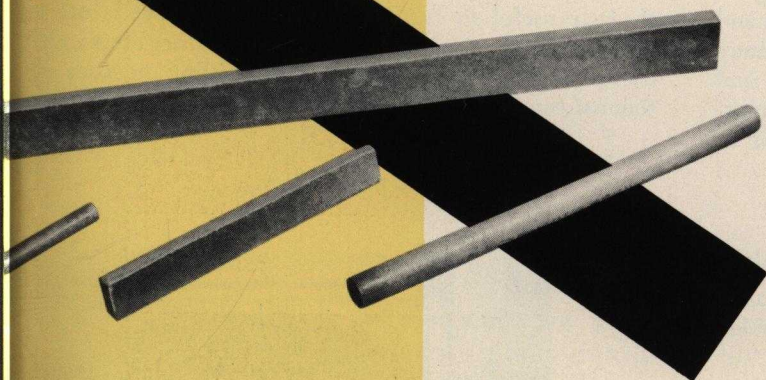
CAR-TOP SHAPES

Shown here are three of CARBORUNDUM's super refractories that give car tops vastly improved life and performance. CARBOFRAX® tile, with their unexcelled hot strength and heat-shock resistance, stay level and true . . . provide a firm, even foundation that lasts and lasts. ALFRAX® BI aluminum oxide brick—made of alumina "bubbles"—insulate at far higher temperatures and stand heavier loads than other insulating materials. MULLFRAX® electric furnace mullite shapes provide good hot strength, chemical stability and high heat resistance.



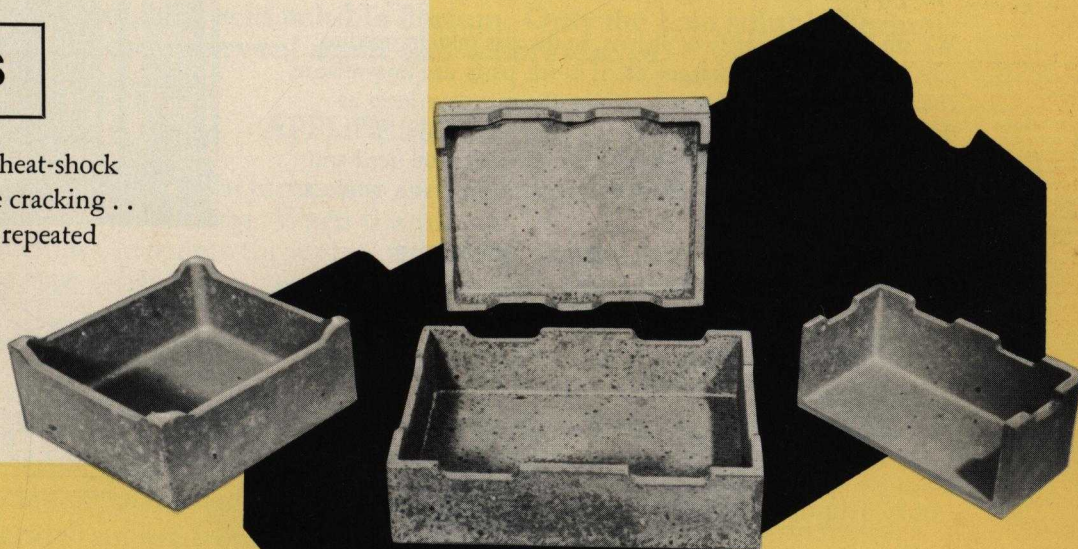
BARS

The hot strength of CARBOFRAX bars keeps them straight, and holds ware safely. They don't tend to sag even under heavy loads and at extreme temperatures. They're thin, crack-resistant, easy to handle. Particularly adaptable to firing long pieces.



SAGGERS

CARBOFRAX saggars have the heat-shock resistance to prevent excessive cracking . . . the physical strength to stand repeated handlings. They transmit the heat so rapidly through their thin walls that you always get completely uniform burning. And there's little chance of staining.



LOOK AT THE PROPERTIES YOU CAN GET

MATERIAL	Silicon Carbide (over 85 % SiC)	Fused Aluminum Oxide	Alumina "Bubble-Brick"	Electric Furnace Mullite
Trade Mark	CARBOFRAX®	ALFRAX® K	ALFRAX® BI	MULLFRAX®
Refractoriness PCE Cone	Cone 37-40	Cone 37-39	Cone 39-40	Cone 38-39
Approximate Weight 9" Str. Brick	9 ¼ lbs	10 ¼ lbs	4 ¾ lbs	9 lbs
Heat Conductivity @ 2200 F in BTU/hr, sq ft and °F/in. of thickness	109 BTU	24 BTU	7 BTU	16 BTU
Relative Resistance to Spalling	High	Good	Good	High
Abrasion Resistance	High	Fair	Low	Fair
Modulus of Rupture @ 2460 F, PSI	800-3125	100-1050	50-250	100-575
Mean Coefficient of Thermal Expansion per °C 25-1400 C	.0000047	.0000081	.0000086	.0000046

PLUS THE ADVANTAGES OF CAR ENGINEERING BY CARBORUNDUM

The most fruitful area in which progress can be made today in ceramic kiln car operation is what may best be termed "car engineering". No longer can just the car-top, the girders, or the tile be considered separately. Performance of each is now related to all the others, and is substantially determined by them. Good structural design in this sense is already an accomplished fact in many plants. And it is paying off in long life and good performance.

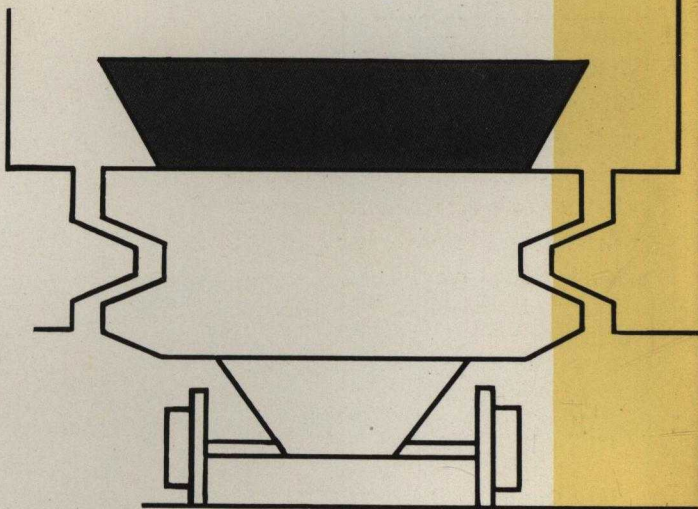
Turn the page to see how car engineering can help you achieve the benefits of good structural design in your operation.

HOW CARBORUNDUM CAR ENGINEERING WORKS

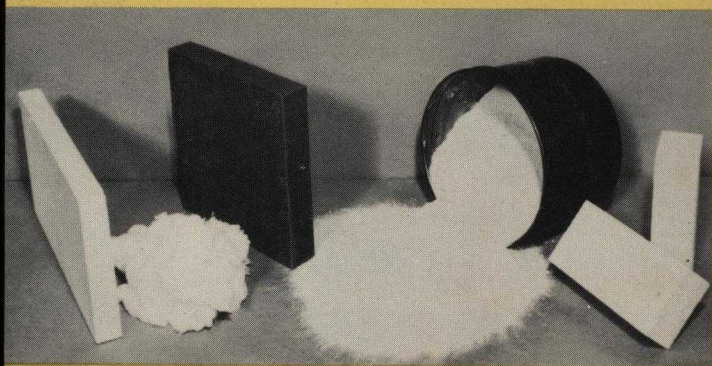
Car engineering begins with a study by the Carborundum field engineer of all the factors affecting the kiln car. These include: kiln operation, variations in firing cycle, car-top construction, load requirements, placing procedures, and method of discharging. The condition of refractories in current use is also checked.

The technical service department considers these factors in the light of their own first-hand experience. A structural design is developed, and is submitted to the customer for review and further discussion, if necessary.

The final recommendation may affect the whole design structure. However, in many cases a simple change in design or material for a localized area may solve the problem.



OUTSTANDING NEW REFRACTORIES DEVELOPED BY CARBORUNDUM



CASTABLE ALUMINUM OXIDE CEMENT: Tiny bubbles of pure alumina and a bonding agent. Easily handled: you just mix with water and pour. Stands up to Cone 32, and has good insulating properties at these high temperatures. Retains its hot strength and is stable under all kiln conditions and atmospheres. Often used to insulate car tops, and for small kiln structures and burner blocks.

ALUMINUM OXIDE "BUBBLE-BRICK": Provides the same properties as the castable cement above, only in bonded form. Has good chemical stability and re-

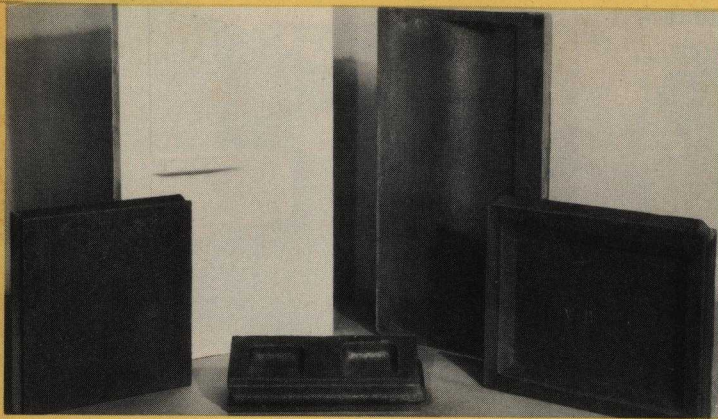
sists extreme heat. "Bubble-brick" are often used as a heat barrier in applications such as car-tops and kiln linings.

REFRAX® SILICON CARBIDE REFRACTORIES: A silicon-nitride-bonded silicon carbide that gives amazingly improved service under extreme conditions. Has many of the properties of CARBOFRAX® refractories, with even greater oxidation resistance, load-bearing strength and heat-shock resistance! Can be made in intricate, close-tolerance shapes (even threaded).

MULLFRAX® ELECTRIC FURNACE MULLITE: Offers high load-carrying capacity plus excellent thermal and chemical stability. Has relatively low thermal conductivity and good resistance to cracking. Often used in car-tops, saggars for high-temperature service, setter tile, preformed burner blocks, sections of kiln lining, piers and muffle supporting arches.

FIBERFRAX® CERAMIC FIBER: This new product provides high insulating and refractory properties in a cotton-like material. Frequently used as a heat-resistant packing in car-tops to prevent sand build-up in joints and subsequent disruption. Also as insulation and as packing for expansion joints and around pyrometer tubes, peep holes and burner blocks.

OTHER SUPER REFRACTORY APPLICATIONS IN THE CERAMIC FIELD



Porcelain enameling furnaces: The same advantages that have brought silicon carbide, aluminum oxide and electric furnace mullite into widespread service in ceramic kilns make these materials equally useful in enameling furnaces. In fact, all three materials can often be used with good effect in the same furnace. For example, silicon carbide and aluminum oxide tile in the hot zone, and electric furnace mullite in the substructure, give balanced refractory and thermal performance. Silicon carbide is often chosen for muffles of continuous and batch-type furnaces, because of its

CONTINUOUS KILNS: CARBOFRAX® silicon carbide muffle in the hot zone of continuous kilns provide highest heat transfer, close heat control and lowest possible fuel costs. Moreover, they are exceptionally refractory, highly resistant to spalling and cracking, and possess good mechanical strength at operating temperatures. ALFRAX® aluminum oxide is another material widely used in muffles. These tiles have a high degree of chemical and thermal stability, and are particularly long lasting. A third material for kiln structures is MULLFRAX® electric furnace mullite. It is extremely resistant to cracking and spalling, has good mechanical strength, and is unaffected by kiln atmospheres. It is used for burner blocks, piers and supporting arches. Finally, FIBERFRAX ceramic fiber is ideal for packing joints.

high rate of heat transfer. It assures rapid, uniform delivery of heat to the ware with minimum fuel input, especially when operating at top speed. On the other hand, aluminum oxide provides long life, chemical stability and a thermal conductivity about three times that of fireclay. This material is particularly useful in furnaces where peak output is not required. For piers, supporting arches and burner blocks, electric furnace mullite is unsurpassed in resisting the loads and thermal conditions found in combustion chambers.

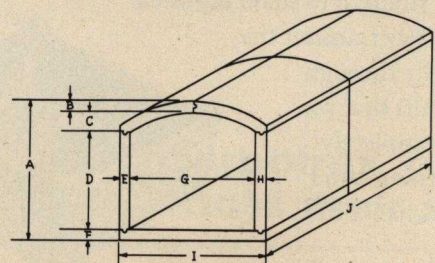
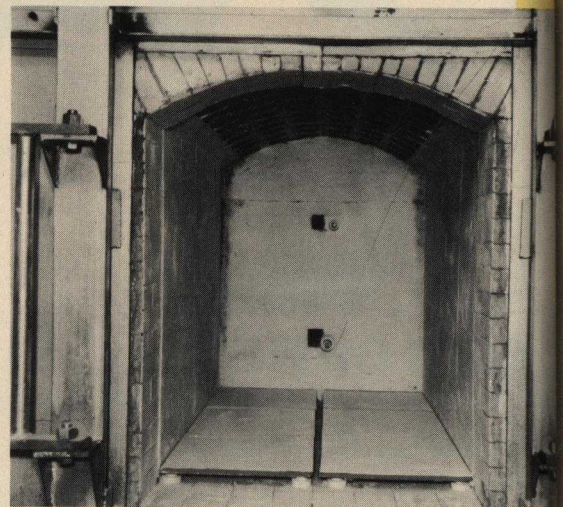
Batch kilns: Operators of batch-type kilns use silicon carbide refractories to speed production, turn out best quality ware and cut firing costs in much the same way larger producers do. These applications include:

- Muffle tile
- Posts (or props)
- Setter tile
- Piers
- Burner blocks (in prefired shape . . . or we can supply the ramming cement)

We stock a wide variety of shapes, so there is seldom need to pay expensive mold charges or, if stock parts are unavailable, chances are the mold for it is among the many we keep as the world's largest manufacturer of super refractories. If you would care for prices, let us know the parts you need and your muffle dimensions (use the diagram below as a guide.)

STOCK SIZES OF CARBOFRAX SETTER TILE FOR BATCH KILN OPERATORS (plain rectangular)

11" x 9" x 1/2"	13 1/2" x 13" x 5/8"
12" x 10" x 1/2"	14" x 14" x 5/8"
11" x 11" x 1/2"	14 1/2" x 14 1/2" x 7/8" (pusher plates)
12" x 12" x 1/2"	16 1/2" x 11 1/2" x 1" (pusher plates)



CARBORUNDUM

TRADE MARK

CHICAGO COPPER & CHEMICAL CO.

Incorporated 1912

Blue Island, Illinois

Oldest Manufacturer of Precipitated Barium Carbonate in the Western Hemisphere

Our FINE, FLUFFY, FREE FLOWING BARIUM CARBONATE

The standard among Ceramic Users for 46 Years

Free Flowing Regular Uses

For the prevention of scum and efflorescence on

Brick
Tile
Terra Cotta
Sewer Pipe
Mortars

As a rat poison

Free Flowing Sulphur Free Uses

As an ingredient in:

Sanitary Enamel
Enamel Frits
Glass
Ceramic Glazes
Carburizing Compounds

For removal of Sulfates from waters and brines

PROPERTIES

Barium Carbonate depends for its effectiveness for its distribution throughout the mass of other ingredients in any mixture. Our Barium Carbonate is uniform in physical properties, does not tend to ball up, cake up or agglomerate and thus is ideally suited to obtain the maximum effectiveness.

Our Free Flowing Barium Carbonate contains 98% acid soluble Barium expressed as BaCO_3 . It is not adulterated. Some competitive materials analyze substantially less than 90% acid soluble Barium. Only the acid soluble Barium can react with sulfates to prevent scum and efflorescence.

APPLICATION

Among clay products manufacturers our surveys have shown that a large majority feed their Barium Carbonate dry. When the process permits we recommend the introduction of Barium Carbonate through a small dry feeder. Sketches of a satisfactory home made type available on application.

SERVICE

Send us samples of your clays, shales and mortar ingredients for analysis free of charge. Write us for a supply of handy mailing cartons for samples.

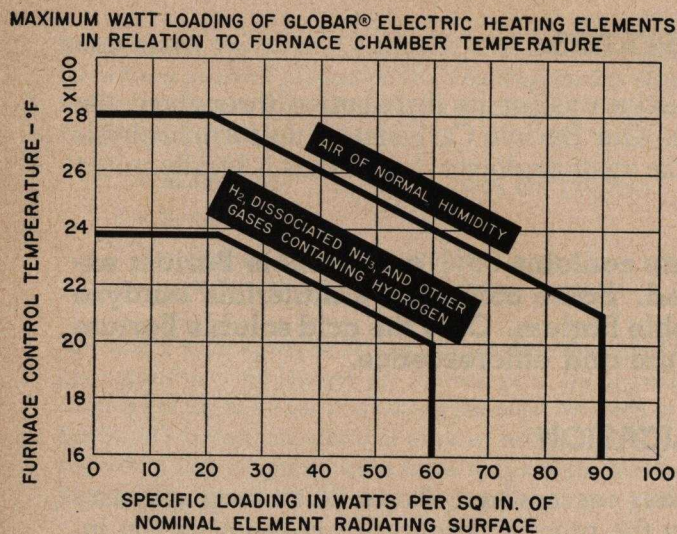
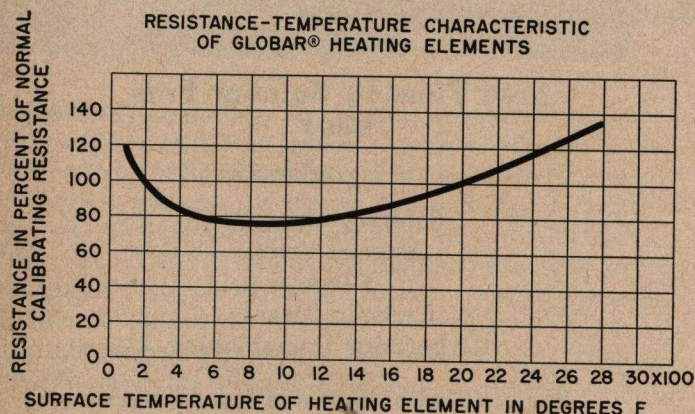
In sampling clay or shale banks, do not send aggregate or average samples, but rather send separate samples from different parts of your bank.

Write or wire us collect. We are prepared to give close personal attention to your problems.

THE CARBORUNDUM COMPANY

Global Plant—Refractories Division—Niagara Falls, N.Y.

**GLOBAR® Delta elements are available
in a wide range of sizes
for kilns operating up to 2800F**



Lower Maintenance Costs, decreased element expense and more economical overall operation are possible with Globar silicon carbide heating elements. While *all* silicon carbide elements increase in resistance with use, Globar Delta elements increase more uniformly and at a slower rate—assuring longer element life, fewer voltage changes, and lower operating costs. When replacement is necessary, Globar Delta elements can be installed in a hot furnace or kiln. Down-time is minimized.

Globar Silicon Carbide AT Type Elements, for use in furnaces and kilns operating up to 2800F, are made in the form of round rods. The element has a central heating section of crystalline silicon carbide and two terminals of a low resistance material. The energy developed in the terminal is only a small portion of the total input to the entire heating element, and most of this energy is useful in heating the walls of the furnace to compensate for a portion of the wall loss which normally occurs. The definite length of heating section, which does not change with use, and the very low resistance terminals assure trouble-free connections and terminals which do not overheat.

AT Type Elements Are Available in diameters from 1/4" to 2 1/8" and in overall lengths from 4" to 105". Elements are made with terminals of various lengths for use with walls made of standard insulating brick and block insulation. Globar elements are manufactured to a resistance tolerance of $\pm 10\%$. When specified, they are supplied in matched sets within a $\pm 5\%$ tolerance. They may be mounted in any position if properly supported and may be connected in parallel, series or a combination of the two.

The low room-temperature resistance, as exhibited by the resistance-temperature characteristic of a Delta element (above left), permits satisfactory periodic as well as continuous operation. The electrical load on the elements (below left) is selected according to control temperature and atmosphere.

To obtain the high efficiency available only with electric heat, consult your furnace builder or Globar's engineering staff for help in the proper selection of elements and controls.

**OVER 15,000 ELEMENTS IN 275 SIZES
IN STOCK AT ALL TIMES**

Shipment of Globar elements can be made from stock or within two weeks when manufacture is necessary.

For full information, contact your furnace builder or write for Bulletin H or Globar Hot Tips. Address The Carborundum Company, Global Plant, Refractories Division, Dept. CD 108, Niagara Falls, New York.



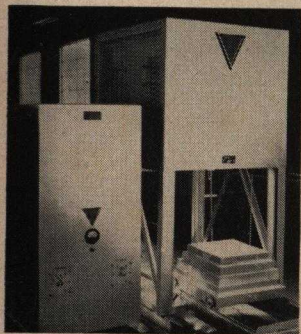
CARBORUNDUM

Registered Trade Mark

THE CARBORUNDUM COMPANY

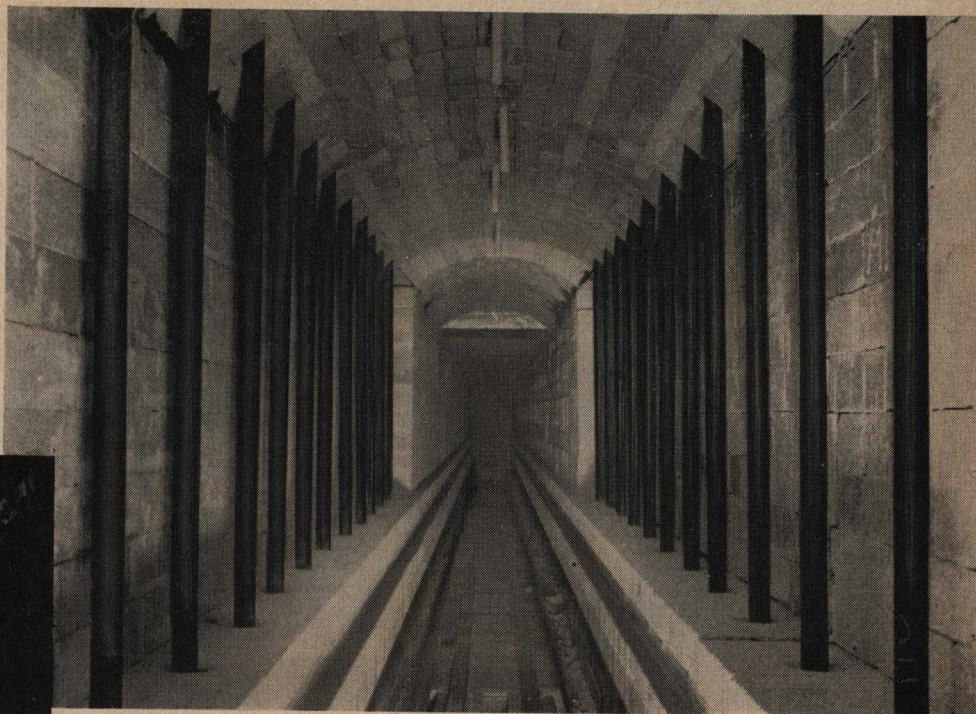
Globar Plant—Refractories Division—Niagara Falls, N. Y.

Typical Ceramic Installations

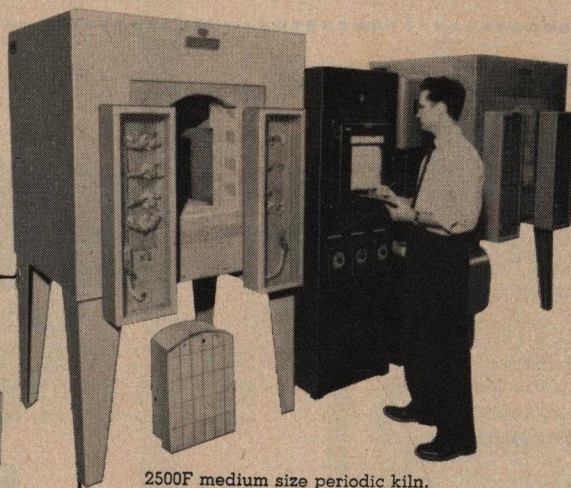
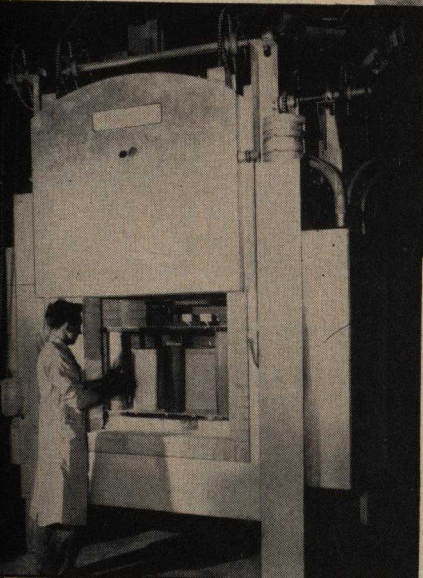


Elevator type high-temperature kiln for operation up to 2700F.

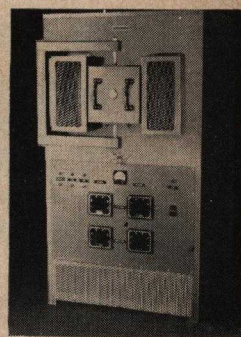
Large double-door periodic kiln.



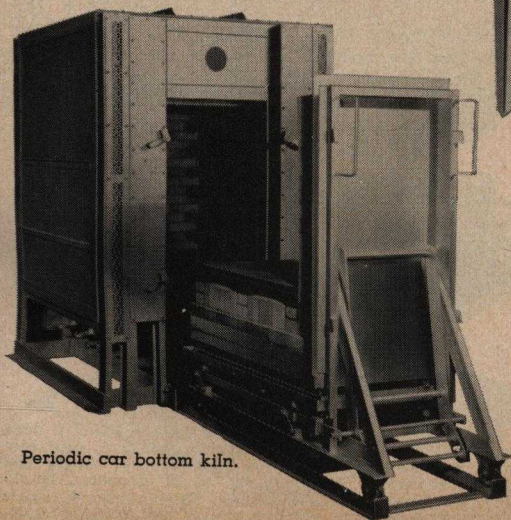
Hot zone of 100 ft. car type tunnel kiln.



2500F medium size periodic kiln.



Small high-temperature periodic kiln package.



Periodic car bottom kiln.

In the ceramic field, Globar Delta silicon carbide elements are used in batch kilns and continuous pusher or car type kilns, with or without special atmospheres, for pilot and production firing of ferrites, titanates, steatites, electric insulators, resistors, refractories, grinding wheels, porcelain enamel tile, dishes, art ware and many other items. Elements are used for bisque firing, glazing and decorating.

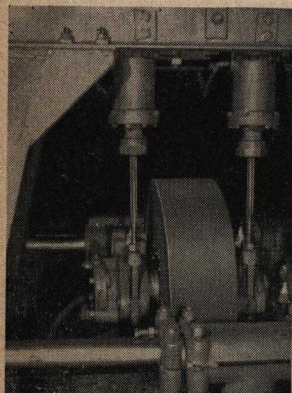
There is a qualified Globar field engineer near you to assist with your firing needs. Contact your furnace builder, or write Department CD 108, Carborundum Company, Globar Plant, Refractories Division, Niagara Falls, N. Y.

CHAMBERS BROTHERS CO.

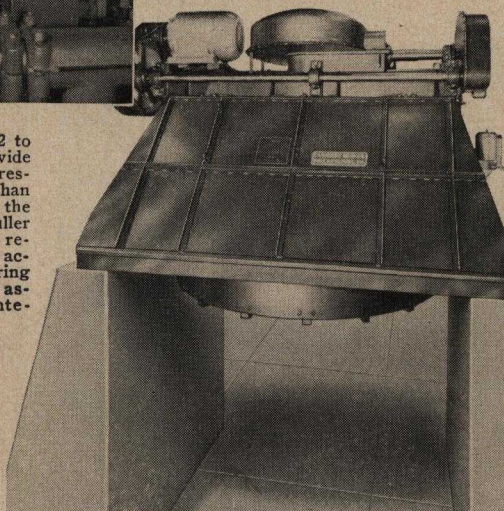
52nd & Media Sts., Philadelphia 31, Pa.

9' or 10' DRY PAN #70 Rim Discharge Grinder

Suspended Design - Air Pressure Control

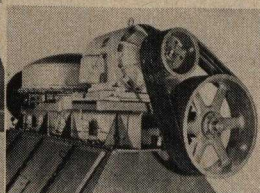


AIR CYLINDERS, 2 to each muller, provide *exact* grinding pressures—from less than dead weight all the way to 10 tons. Muller assembly is easily removed by rocking action, separate bearing housings further assure quick maintenance.



These famous Chambers machines, in their latest, most improved design, properly relate grinding pressures, depth of material used in pan, and large discharge areas—for maximum production. Unique balance and control are made available to the operator through Chambers air-pressure control—2 air cylinders per muller, automatic feed control to the pan, and extra-large screen area (39 Sq. Ft. for 9' pan, 51 Sq. Ft. for 10' pan). Surrounding dust-tight enclosure isolates all components of drive from grinding areas, provides convenient attachment to centralized dust-collecting systems.

(left) The completely self-contained 60 to 75 HP drive makes separate foundations and long V-belts unnecessary. High starting torque motors eliminate clutches and subsequent maintenance costs. At other end of dust-tight enclosure, dual grease lubrication pumps and distribution valves simplify daily maintenance and insure against premature parts failures. Dust-tight covers completely protect hardened, cut-steel double-gear reduction (20:1).



Absence of lower step bearing makes practical direct hopping to conveyor or bucket elevator. Conventional scrapers and bottom boards reduce over-all installation height, providing same efficient discharge. Simple foundation piers are money- and space-savers.

GRINDING PRESSURE RANGE

Air Pressure in Cylinder.....	75 lbs.	100 lbs.	125 lbs.	150 lbs.	175 lbs.
Total Crushing Pressure on Muller.....	*11,900 lbs.	*14,000 lbs.	*16,000 lbs.	*18,100 lbs.	*20,100 lbs.

*Effective dead weight of muller assembly is 5,880 lbs.

OTHER MACHINES IN THE COMPLETE CHAMBERS LINE

Automatic Sewer Pipe Forming, Finishing & Setting Machine, with built-in Scrap-Disposal Pug Mill.

Sewer Pipe Extruders manufactured either as combined machines or with dual drives.

Smooth Roll Crushers & Disintegrators, 16" and 24" face—anti-friction bearings; automatic resurfacing attachment built into new machinery.

Conical Roll Stone Extracting Crusher—threaded or smooth shells for ejection of stones and pebbles 1" +.

Special De-Airing or Non-De-Airing Mixers and Extruders for general industry.

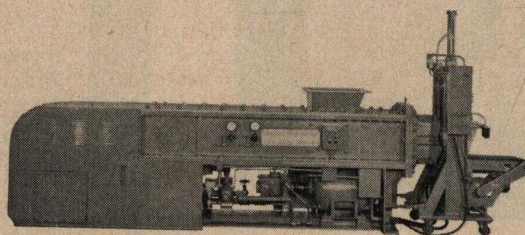
Crucible Manufacturing Machines.

Screw Press for stoppers & specialty dry press products.

#4 Keystone Repress.

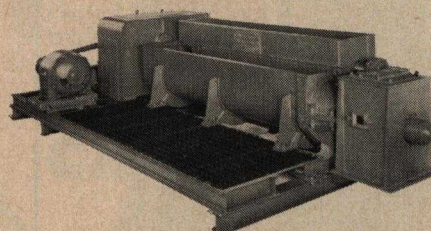
Authorized manufacturer of Ni-Hard wearing parts.

TEST FACILITIES AVAILABLE



Horizontal, Hydraulic PLASTIC EXTRUDER

Introduced by Chambers to meet the need for a ram-type extruder for highly abrasive mixes not suitable for auger extrusion, this automatic unit is completely self-contained. Cycling is automatic or manual, with Hydraulic Cutter. Extrusion chamber, 12" x 15", is lined with heavy, precision-ground Ni-Hard plates. 3,000 P.S.I. hydraulic system, 75 tons extrusion pressure.

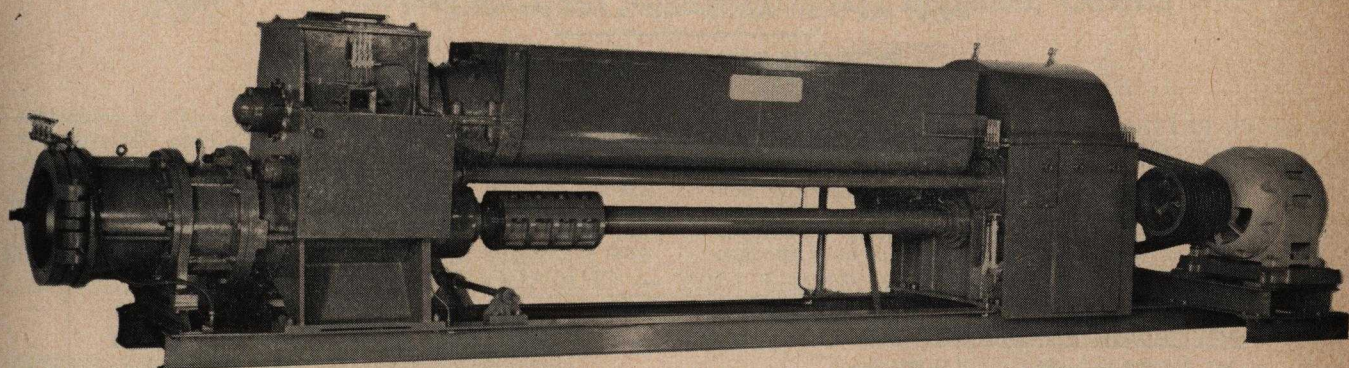


TWIN TUB PUG MILL

This unit provides 24' of open pugging (2 12' tubs), or 16' of open mill and 8' under vacuum. Shown with upper vacuum case to provide complete two-level, dual drive combined machine. Vacuum pugging can be provided in lower tub. **Single shaft and double shaft** designs also available. Tubs from 12" to 52" diameter, lengths 6' to 16'. Double gear reductions; spur or helical gearing, flame-hardened. Chambers reverse spiral knife drilling guarantees greatest mixing and pugging action.

CHAMBERS BROTHERS CO.

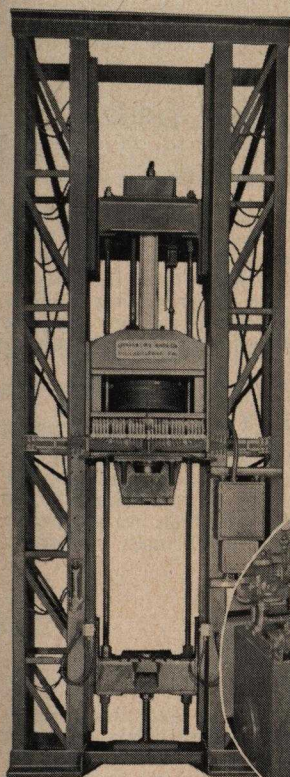
52nd & Media Sts., Philadelphia 31, Pa.



New
#12 AC COMBINED
DE-AIRING MACHINE

Hi-Power model, up to 300 HP, combines all-steel construction and generous use of alloy materials to match today's brick and hollow tile standards with safety factors provided for tomorrow's more exacting extrusion problems. 18 $\frac{3}{4}$ " auger, fed by 21" augers in vacuum case; 12" pug mill tub. Other auger combinations available.

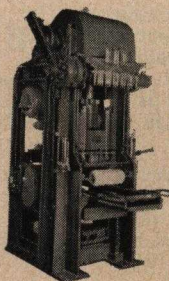
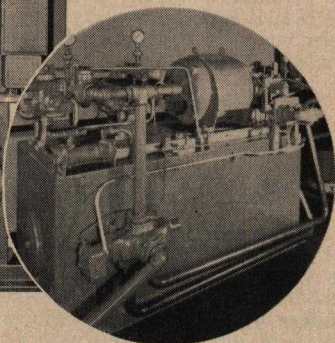
New, High Speed General Duty 30-TON PRESS



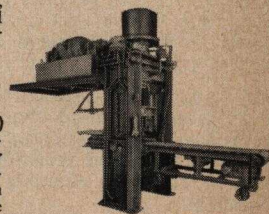
Just developed by Chambers, a high speed press to fill large or small refractory plant requirements. Rapidly and economically makes:

1. Sleeves & nozzles to 18" long burned,
2. Runner brick & Bottom block,
3. Checkers & pierced shapes to 12" thick burned, &
4. As production repress with automatic feeder and off-bearing belt, double brick 13 $\frac{1}{2}$ " x 6", single block up to 15" x 18" burned (larger block on special order).

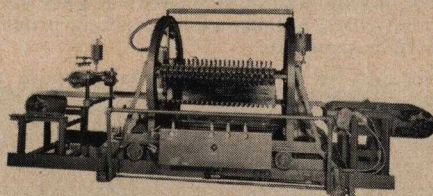
50 HP hydraulic system drive operates two 70 GPM low pressure pumps, one 10 GPM high pressure pump. Press operation, through a single high pressure 5" Dia. x 48" cylinder, produces up to 30 tons (20 cycles per Min. at full stroke)—more than any other conventional represses or runner-brick type presses.



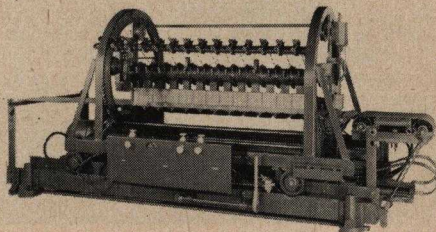
#6 REPRESS (Left)—The first truly modern repress available to the refractory industry. Delivers 25 tons working pressure, with variable speed—7 to 30 strokes per minute. 15 HP. Maximum green block size, 27" x 15" x 6 $\frac{3}{8}$ ". Triple crosshead construction for absolute plunger rigidity and accuracy.



75-Ton HYDRAULIC PRESS (Right)—For large blocks and deep piercing, pressures and piercing capacity being in excess of present requirements. The hydraulic system can be coupled with sleeve-and-nozzle press for alternate operation. Capacity: Max. Single block, 18" x 24" x 12" burned; Max. piercing depth, 12" burned; Max. daylight opening, 4'6".



BRICK CUTTER—Shown is cutter with 21-brick platen—8" Norman or SCR—with built-in pulley for off bearing belt. Maximum number of brick—27 per cut; platen lengths of 42", 54" or 68"; maximum normal operating speed, 18 cuts/Min. Measuring conveyor can be built in any length to suit plant; standard, 3'.



TILE CUTTER—Shown is Model #30 for 12 5"—tile cuts (adjustable platens for refractory use). Reciprocating motions under smooth air control, with tied-in air clutches to actuate rotary motion. Capacity in cross sections: up to 11" x 20", 15 $\frac{1}{2}$ " x 15 $\frac{1}{2}$ " and 11" x 18 $\frac{1}{2}$ " on edge—all on special order. Platen lengths and speeds as above. Extra-large diameter reel available for oversize cross sections.

SERVING YOUR INDUSTRY FOR OVER 100 YEARS

1857 1958

CHICAGO VITREOUS CORPORATION

A Division of The Eagle-Picher Company

Main Office and Plant—Cicero 50, Illinois

Representatives in Australia, New Zealand, Mexico, Argentina, Brazil, Chile, Colombia, Peru, Uruguay, Italy, Israel, Egypt and South Africa—Cable Address: CHIVIT

PORCELAIN ENAMEL FRITS

For Every Type of Application

Chicago Vit FRITS assure lower production costs through consistent uniformity, excellent workability, a reduction of costly re-work and fewer rejects. This is no accident! Chicago Vit has devoted over 40 years to research and development work to produce the industry's most comprehensive line of FRITS. The manufacturing experience gained during all those years, the finest and most modern

FOR FINEST FRIT — CHICAGO VIT

testing equipment and facilities and the skill of competent research technicians have provided Chicago Vit with the basis for rigid frit manufacturing control standards that are second to none. Manufacturers of highest grade porcelain enamel products use Chicago Vit FRIT year in and year out. We would be pleased to arrange a demonstration in your plant.

PORCELAIN ENAMELING CLAYS

Hydro-Cleaned* . . . Air Floated

Q Clay, Hydro-Cleaned*—A low-set hydro-cleaned clay, especially recommended for dipping cover coat porcelain enamels where low set and high specific gravity are desired. It imparts good opacity, smooth texture and excellent properties of distribution during the dipping operation. Especially well adapted to the dipping of hollow ware.

A Clay, Hydro-Cleaned*—A hydro-cleaned clay imparting good opacity and luster to high opaque zirconium cover coats. This clay has good suspending properties, develops average set and permits the use of high specific gravities in spraying, where this quality in the slip is desired. It is a blend of domestic clays unusually well adapted for use in zircon frits.

H Clay, Hydro-Cleaned*—A hydro-cleaned clay imparting high gloss and good opacity to zirconium cover coats. This clay has good suspending properties, a little less set than A Clay and good working properties. It is well suited for use in 1300° F enamels as well as in conventional type enamels.

L Clay, Hydro-Cleaned*—A high set clay with good suspension properties. Imparts high gloss to cover coat enamels. Provides good color for titanium enamels.

X Clay, Air-Floated—An air-floated, dual purpose clay which has excellent suspending properties and imparts a high set to milled porcelain enamels. Especially blended for acid resisting and antimony frits imparting high opacity, good working properties and high luster. Highly recommended for ground coats, because of its draining properties and excellent bubble structure.

D Clay, Air-Floated—An air-floated special purpose clear clay recommended for dark colors giving excellent results in blue, black and other bright colors. It is equally well adapted to both steel and cast iron enamels. Provides good suspension of the porcelain enamels and develops high set.

CHICAGO VIT HAS A CLAY FOR EVERY NEED

*Exclusive Chicago Vit processing that really cleans the clays.

QUINN-ROGERS VITRA-PUMP

The Quinn-Rogers Vitra-Pump is a diaphragm type pump especially engineered to handle vitreous enamel and pottery slips. It is designed and constructed of materials which assure maximum efficiency and long life in service. Some of its outstanding features include the following: No gears or impellers to wear out . . . simple design and rugged construction . . . simple flexible mounting arrangements . . . variable capacities . . . ball bearing construction . . . no packing to wear out . . . no cleaning or oiling . . . constant volume. Diaphragms are of natural rubber or of synthetics depending upon the material to be pumped. Available in three capacities—5-12 G.P.M., 20-25 G.P.M. and 40 G.P.M.

McDANIEL GRINDING BALLS

Sizes— $\frac{1}{2}$ ", $\frac{3}{4}$ ", 1", $1\frac{1}{4}$ ", $1\frac{1}{2}$ ", 2", $2\frac{1}{2}$ ", 3" diameter.

McDANIEL REGULAR AND HIGH DENSITY MILL LININGS

Designed exclusively for porcelain enamel frit grinding. Every McDanel brick is fired for an unusually long period assuring complete and correct vitrification, an essential to consistently uniform milling and longer mill lining life.

McDANIEL MILL HEAD ASSEMBLY

McDanel mill head and door frame assemblies assure clean enamels because "there's no grinding on iron." Porcelain blocks set in the mill head and around the door frame eliminate all chances of contaminating the mill batch . . . provide long wear . . . make it impossible for the mill charge to grind against a metallic surface. Exclusive unloading tube permits unloading or sampling without removal of mill head.

COORS HIGH DENSITY GRINDING BALLS

Sizes—1", $1\frac{1}{4}$ ", $1\frac{1}{2}$ ", 2" diameter. These high density balls are approximately 40% heavier than standard porcelain balls and provide up to 50% faster grinding, providing millroom savings.

COORS HIGH DENSITY MILL LININGS

FRANTZ FERROFILTERS

The standard essential equipment used by the porcelain enamel industry for removal of contaminating iron particles from enamel slip. Complete selection of sizes to meet individual production requirements. Gravity type for general millroom use. Pipeline type for use in circulating systems on ground coat dip tanks, and for enamel storage pumping systems. Both assure complete removal of magnetic particles from enamel slip.

ROTOSPRAY

A rotary spray sifter designed for sifting or straining enamel to eliminate lumps. Two sizes are available, the Standard Model which has a capacity of approximately 700 gallons per hour and the Junior Model which has a capacity of approximately 350 gallons per hour through a 60-mesh screen.

STEVECO MILLS

CHICAGO VIT COLOR OXIDES

Chicago Vitreous color oxides meet the exacting requirements of the manufacturers of colored porcelain enameled products whether they be signs, stoves, household appliances, table tops, architectural porcelain or many other items. Large quantities of the highest quality color oxides are stocked in our plant ready to be quickly blended to meet your exacting requirements.

PARTIAL LIST EQUIPMENT AND SUPPLIES

Asbestos Mitts, Cloth Patches, etc.	Pickle Room Supplies	Separators, Oil and Water
Brushes, all types	Rubber Aprons	Sieves, Testing
Burning Tools	Rubber Gloves	Spray Equipment.
Chemicals	Thermometers	Guns, Booths, Pressure Tanks, etc.
Control Equipment	Porcelain and Steel Jacket Jar Mills for laboratory use	Tanks for enamel storage
Filters for nickel and neutralizer tanks	Pumps for handling Enamel slips	Water Treatment De-ionizer Units
Mills, Laboratory	Respirators	Softeners
Mill Room:	Respirators	Wire Cloth
Dippers and Scoops	Rubbing Stones	Wool Dusters



COAST METALS, INC.

Little Ferry, N. J.

COAST METALS (CANADA), LTD., Hamilton, Ontario

HARDSURFACING WELD RODS FOR CERAMIC PLANTS

For over twenty years, COAST METALS cast hardsurfacing weld rods have been protecting ceramic equipment against wear.



Salvaged augers, hardsurfaced with Coast Metals, have produced over 14,000,000 brick.

No. 1 & 101

Good abrasion resistance. High impact strength. Acquires high work polish.

No. 4 & 104

Extremely dense. High abrasion resistance. Low coefficient of friction.

No. 10 & 110

Retains excellent wear resistance at elevated temperatures.

No. 112

Outstanding resistance to abrasion and impact. Most popular in ceramic plants.

No. 15 & 115

Excellent resistance to abrasion, impact, corrosion. Good high temperature qualities. Excellent edge strength.

No. 31 & 131

A new Carbon, Chromium, Molybdenum, Cobalt Iron Base Alloy. Excellent resistance to abrasion, low coefficient of friction, hardest of all listed alloys.

No. 53

A new Nickel base Chrome, Silicon, Boron Alloy. Very low coefficient of friction. Very smooth deposits, acquires excellent polish in service.

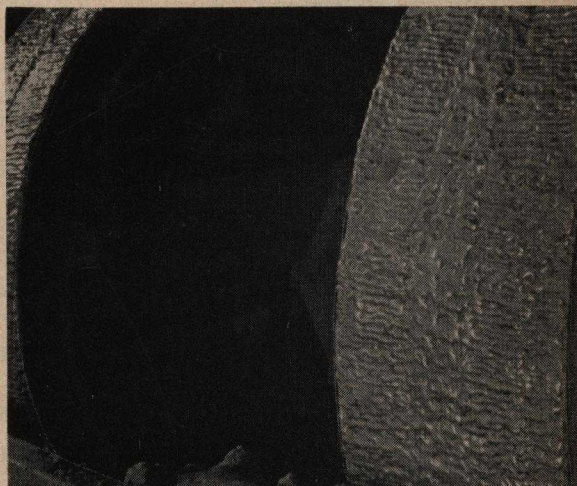
NOW—COAST METALS offers a new line of tube rods. Designed to meet demands for low cost hardsurfacing, these new high alloy tube rods combine maximum wear resistance with good welding characteristics.

192T

A high chromium, high carbon alloy, which combines excellent abrasion resistance with good impact and heat resistance.

196T

A high chromium, high manganese alloy. Has excellent resistance to impact, abrasion plus impact, straight abrasion and heat, with good work hardening characteristics.



Muller tires grind better, last much longer, when coated with Coast Metals hardsurfacing.

NOTE: All of the above alloys are also available in coils for automatic submerged arc welding. Please specify if desired in this way.

The alloys listed above are most widely used in ceramic plants. Other alloys for special wear problems are also available. Proper alloy selection will vary depending on abrasive quality of clay being processed.

COLUMBIAN CARBON COMPANY

Mapico Color Unit

380 Madison Avenue, New York 17, N. Y.

Branch Offices, Agents and Warehouses maintained in principal cities to assure quick service

**Soft and
Hard Ferrites
for the
MAGNETIC
CERAMICS
INDUSTRY**

MAPICO PURE SYNTHETIC IRON OXIDE REAGENTS



Columbian has had 50 years experience in the business of manufacturing pure synthetic iron oxides. They can be produced by several practical procedures to give a variety of characteristic particle shapes and particle size ranges. The methods by which MAPICO® Pure Iron Oxides are manufactured were chosen because they enable careful control of preselected characteristics.

MAPICO PURE IRON OXIDES

- (a) are strictly uniform from shipment to shipment
- (b) are reactive at the high temperatures customarily used in the ceramic industry
- (c) are available in three different particle shapes any of which may be had in several ranges of particle size
- (d) are of high purity and free from harmful impurities
- (e) give controlled shrinkage
- (f) give controlled electronic characteristics
- (g) are produced in ample supply by a large, modern, technically staffed plant

DATA ➤ MAPICO PRODUCTS	COMPOSITION	PARTICLE SHAPE	PREDOMINANT PARTICLE SIZE (Microns)	APPARENT DENSITY		% PURITY	% MOISTURE (Loss at 105° C)	LOSS ON IGNITION	TYPICAL CHEMICAL ANALYSES				% Al ₂ O ₃	% Cu	% Mn
				S.V.†† GMS./CM. ³	TAPPED GMS./CM. ³				% WATER SOLUBLE SALTS	% SiO ₂	% TiO ₂	% SO ₃			
				Min. Max.	Min. Max.	Min. Max.	Min. Max.	Min. Max.	Min. Max.	Min. Max.					
Yellow Light Lemon 100	ferric oxide hydrate	acicular	0.4-0.8	.14	.35	98.8 99.2	.30 .50	11.5 12.0	.04 .08	.05 .15	.002 .004	.20 .60	.001 .002	.03 .05	.015 .025
EG-1*	magnesium ferrite	acicular	0.4-1.2	.18	.40	99.3 99.6	.10 .20	.05 .10	.35 .45	.05 .10	.002 .004	.10 .30	.001 .002	.02 .04	.015 .025
EG-2**	zinc ferrite	acicular	0.4-1.2	.27	.59	99.5 99.7	.10 .20	.05 .10	.05 .10	.10 .20	.002 .004	.02 .04	.001 .002	.02 .04	.010 .015
EG-3	gamma ferric oxide	cubical	0.3-1.2	.39	.71	98.8 99.0	.05 .10	.80 .10	.05 .10	.03 .06	.02 .04	.05 .10	.002 .005	.002 .004	.10 .20
Red 110-2	alpha ferric oxide	cubical	0.3-1.2	.33	.67	99.1 99.4	.05 .10	.25 .35	.05 .10	.03 .06	.02 .04	.10 .15	.002 .004	.002 .004	.08 .15
EG-60	alpha ferric oxide	cubical	2.0-4.0	.45	1.00	99.3 99.6	.05 .10	.2 .3	.05 .10	.01 .02	.02 .04	.10 .15	.002 .004	.002 .004	.08 .15
EG-80	alpha ferric oxide	cubical	3.8-5.9	.85	1.74	99.3 99.6	.05 .10	.10 .20	.05 .10	.03 .06	.02 .04	.03 .06	.002 .004	.002 .004	.08 .15
Red 297	alpha ferric oxide	spheroidal	0.3-0.8	.30	.59	99.3 99.6	.05 .20	.30 .60	.08 .20	.05 .15	.001 .003	.05 .25	.01 .02	.001 .003	.01 .02
Red 347	alpha ferric oxide	spheroidal	0.3-0.9	.32	.61	99.4 99.7	.05 .20	.20 .50	.05 .20	.05 .15	.001 .003	.05 .20	.01 .02	.001 .003	.01 .02
Red 387	alpha ferric oxide	spheroidal	0.3-1.1	.33	.69	99.4 99.7	.05 .20	.20 .50	.05 .20	.05 .15	.001 .003	.05 .15	.01 .02	.001 .003	.02 .03
Red 477	alpha ferric oxide	spheroidal	0.4-2.0	.36	.74	99.5 99.8	.05 .15	.15 .45	.04 .15	.05 .15	.001 .003	.05 .10	.01 .03	.001 .003	.02 .04
Red 567	alpha ferric oxide	spheroidal	0.4-2.6	.37	.74	99.5 99.8	.05 .15	.15 .45	.04 .15	.05 .15	.001 .003	.05 .10	.01 .03	.001 .003	.03 .06
Red 617	alpha ferric oxide	spheroidal	0.4-3.7	.39	.74	99.5 99.8	.05 .10	.15 .35	.04 .10	.05 .15	.001 .003	.05 .10	.01 .03	.001 .003	.03 .10
Red 516-M	alpha ferric oxide	acicular	0.3-1.0	.14	.32	97.0 98.3	.10 .30	1.0 2.2	.10 .20	.05 .15	.002 .004	.15 .30	.001 .002	.03 .05	.015 .025
Black†	synthetic magnetite	cubical	0.2-0.8	.34	.71	99.0 99.2	.05 .20	.70 .90	.05 .10	.03 .06	.02 .04	.03 .06	.002 .004	.002 .004	.20 .25

*MnO 18.7-19.2%—U.S. Patent 2,692,120

*MgO 18.7-19.2%—U.S. Patent 2,502,130

**ZnO 32.6-32.8%—Pat. Appl. For

†FeO 21%—22%

††Scott Volumeter

Samples are available on request and our trained technicians who are continually conducting ferrite research concerned with the use of Mapico Iron Oxides are at your service whenever desired.

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General Offices: (Phone Academy 2-9021) Clover, S. C.

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HIGH GRADE KYANITE - RAW or CALCINED (MULLITE) IN UNLIMITED SUPPLY

• High in Alumina • Low in Iron • Light in Color • P.C.E. 36-38

It hardly seems necessary, in these modern days in the ceramic industry, to go into great detail in describing American Kyanite or in praising its virtues when used either in the high temperatures of refractory work or the natural room-temperature of ordinary ceramic service.

With its formula, $3\text{Al}_2\text{O}_3 \cdot 3\text{SiO}_2$, and its property of converting over to mullite, $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$, during calcining, kyanite was early recognized as a "natural" for super-duty refractory service, and it is now a standard ingredient of cements, mortars, ramming mixes, insulating brick, fire brick, kiln furniture, glass house refractories, special shapes, etc., subject to high temperatures.

In more recent years ceramic engineers have been taking advantage of the wonderful strength-giving

and heat shock resisting properties of this natural "pre-fabricated" mullite crystal, and our calcined kyanite has made big strides in ordinary ceramics. This progress has been aided by the fact that, while kyanite thrives on heat, these ceramic bodies show the unmistakable signs of its presence even when fired at cone 9 or lower. We have some technical data sheets substantiating these statements and will be glad to send you papers showing the performance of our kyanite in sanitary ware, porcelains, wall-tile and precision casting molds if you will send your request to our New York Office.

And of course we shall welcome your request for sample bags of our material if you will pick out the grain sizes, raw or calcined, which interest you and advise us how much of each is desired.

Shipped in Grain Sizes: 35 mesh - 48 mesh - 100 mesh - 200 mesh - 325 mesh

COMMERCIALORES

INCORPORATED

Kyanite

Mullite

Clover, South Carolina

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30 Church St., New York 7, N. Y.

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Nepheline Syenite • Feldspar • Rock Quartz • Aplite • Flint
Beryl • Ground Mica • Silica Sand.

GLASS INDUSTRY

Nepheline Syenite. Potash and Soda Feldspars, High Alu-
mina—all standard mesh sizes. Low Iron Silica Sand. Aplite.

POTTERY INDUSTRY

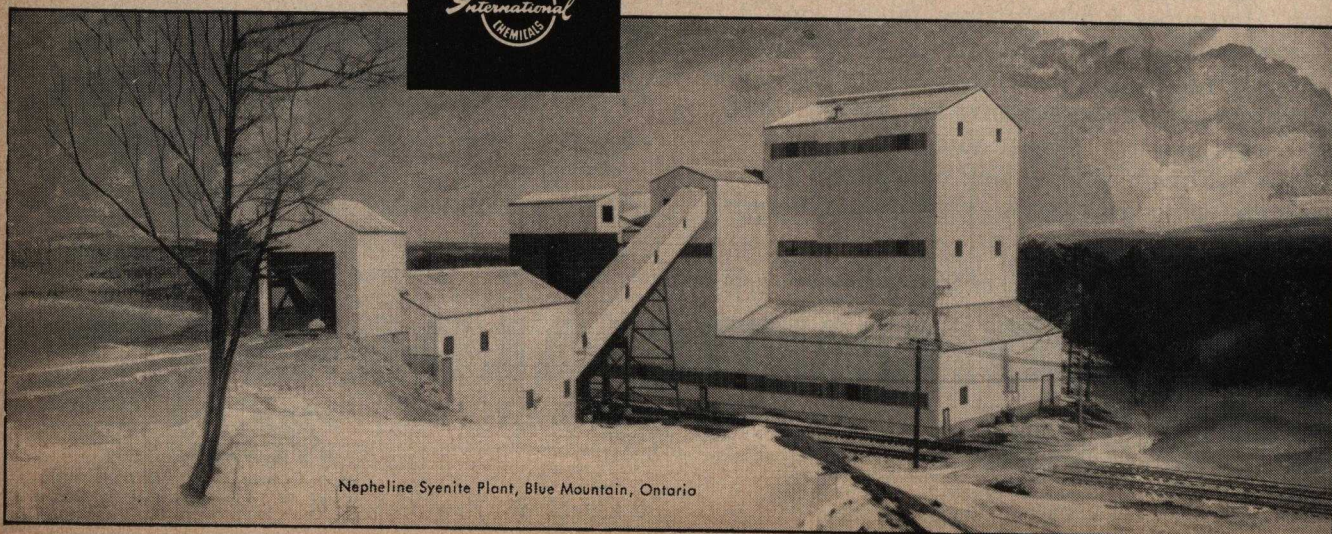
Nepheline Syenite. Potash and Soda Feldspars for bodies
and glazes—all standard mesh sizes. Potters Flint.

PORCELAIN ENAMEL INDUSTRY

Nepheline Syenite. Potash and Soda Feldspars for all types of
porcelain enamel—all standard mesh sizes. Ground Quartz.

GEOGRAPHICAL LOCATION

Geographical location of Consolidated plants
insures minimum freight rates and prompt delivery.



Nepheline Syenite Plant, Blue Mountain, Ontario

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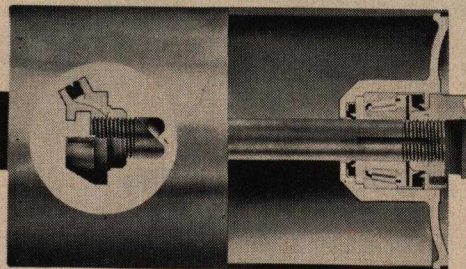
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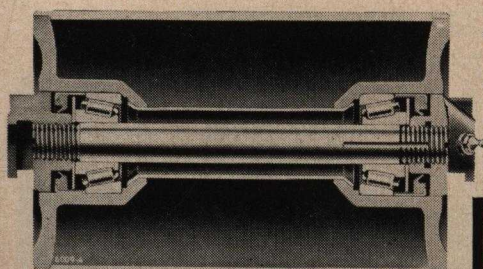
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Continental Unit-Sealed

"UST" Conveyor Idlers are pre-lubricated for longer life and minimum maintenance.

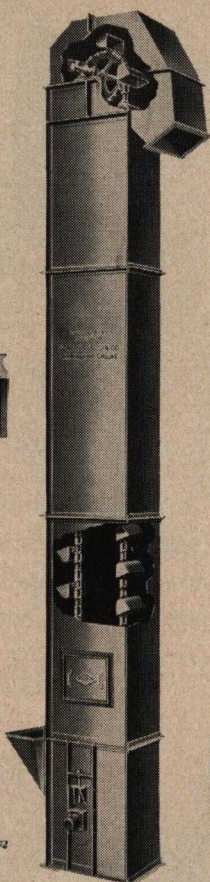
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Continental Standard

"TG" Conveyor Idlers are top quality idlers with standard grease fittings for ease of lubrication.

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**SPECIAL
MACHINERY**
built to
your
specifications



ELEVATORS

Continental manufactures a complete line of Bucket and Screw Elevators and Conveyors. Drives, Buckets, Replacement Screws, and all accessories carried in stock. For information on Screw Elevators, write for Bulletin ID-541; on Bucket Elevators, Bulletin ID-521.

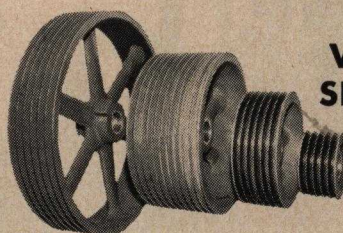
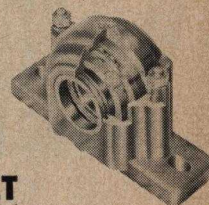


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A full line of conveying and elevating machinery accessories is carried in stock for immediate shipment.

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All types and sizes:
anti-friction and babbitted.

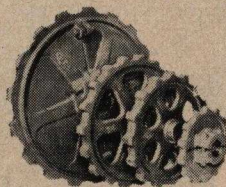
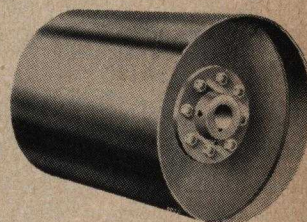


V-BELT SHEAVES

V-Belts or complete drives.

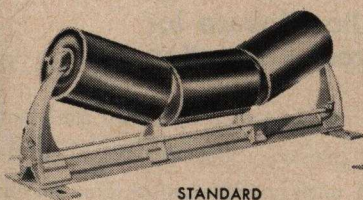
PULLEYS

Conveyor and transmission pulleys; welded steel, cast Meehanite®. Standard, bolted, "Clamp Tite" or "Taper Lock" hubs.

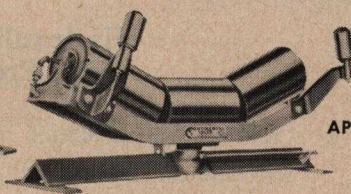


SPROCKETS

Cast and cut tooth. Meehanite® and steel. Most standard types and sizes FROM STOCK; others made promptly to order.



STANDARD



SELF-ALIGNING

Continental Conveyor Idlers

Continental Idlers are available in all standard and many special types — 20°, 35° and 45° troughing, flat belt, picking table, grain concentrator and impact, standard and heavy duty. Stocked for immediate shipment.

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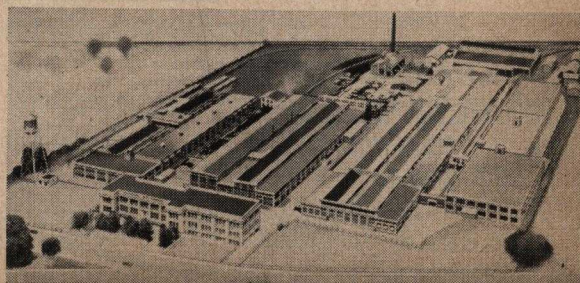
AIR VIEW OF OUR MODERN PLANT AT BIRMINGHAM

This 22-acre plant, with 10 acres under roof, contains the South's largest modernly equipped machine shop, a complete Meehanite® foundry, fabricating and assembly shops. Call on Continental first for all your conveying and elevating requirements.

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APRON CONVEYORS — BELT CONVEYORS — SCREW CONVEYORS
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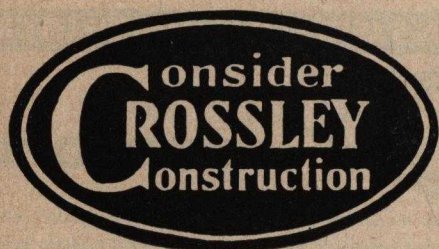
Your inquiries on any conveying and elevating needs will be welcomed



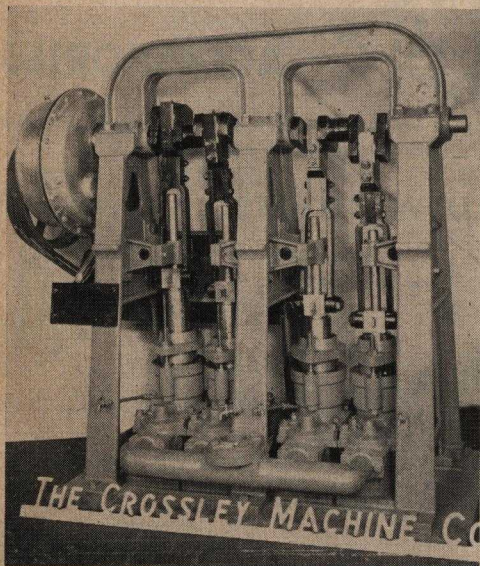
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301 Monmouth St.

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Since 1879 a famous name with the Pottery Trade

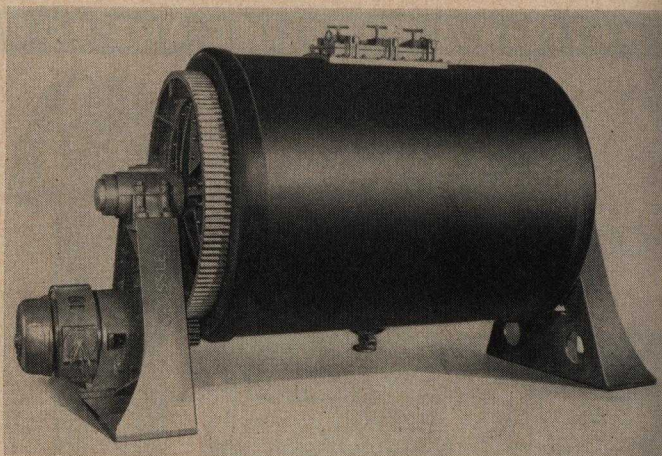
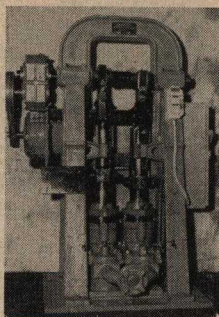


Four Cylinder Slip Pump

Finest slip pump manufactured. Latest design, heavily constructed, furnished with steel pistons, chrome plating optional, non-pulsating. Capacity of 40 gals. per min. at 40 r.p.m.

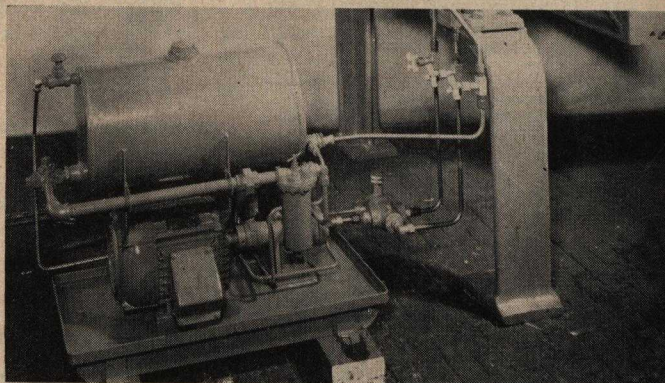
Two Cylinder Slip Pump

Same general description as 4 cylinder pump except capacity of 20 gals. per min. at 40 r.p.m.



Style "D" Ball or Pebble Mills

Latest design, heavily constructed, with large oversize bearings. Roller Bearings optional. High "A" stands eliminate necessity of installing foundations above floor line, thereby permitting higher receptacle for discharged materials. Larger mills have all steel construction.



Hydraulic Closure for Filter Press Operation

Central pumping station complete with reservoir and motor will take care of ten filter presses. 50 tons maximum pressure per closure. Fitted with rapid closure and opening device and individual locking device on each press.

LEADING MANUFACTURERS OF:

BLUNGER MILLS
DRY PRESSES
DUST MILLS
FILTER PRESSES
JIGGERS
LABORATORY EQUIPMENT

LAWNS
PANS, WET OR DRY
PEBBLE & BALL MILLS
PUG MILLS
PUMPS, SLIP & GLAZE
TILE PRESSES

THE CROSSLEY MACHINE CO.

Manufacturers of

Clay Working Machinery

Pottery, Electric Porcelain

Tile Making & Clay Washing

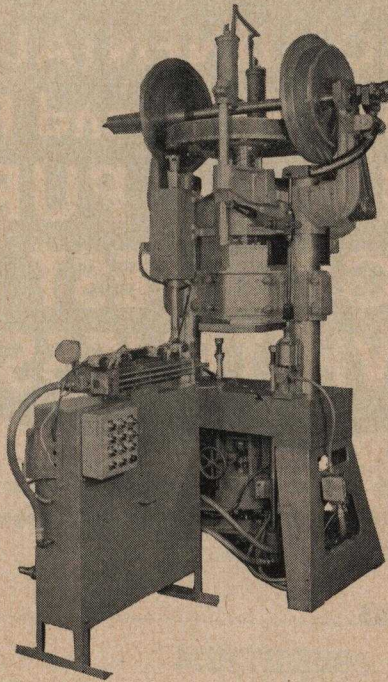
Machinery

CROSSLEY AUTOMATIC TILE PRESS

One Man Easily
Operates 4 Presses—
Push Button Control

Completely Automatic
From Dust Feeder Thru
Ejection of Tile

Constant Lug Height
and Easy Deairing
With Neutralizer



HIGHEST PRODUCTION FOR GREATEST OUTPUT

Greatest capacity 6-4 $\frac{1}{4}$ x 4- $\frac{1}{4}$
tiles per cycle at 10-12 cycles
per min.

All Steel Construction.

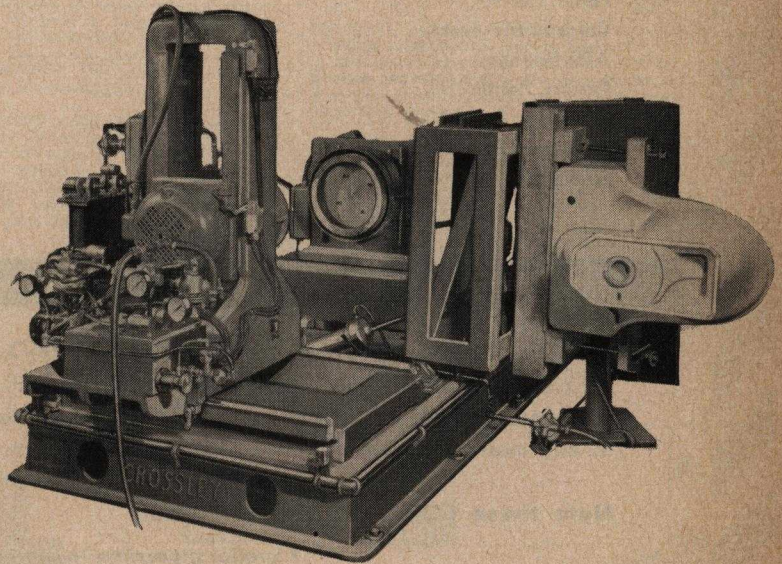
2 Air Brakes—4 Post Ejection
—7 $\frac{1}{2}$ H.P. Motor.

Rates 125 TON.

Automatic Attachment
May be purchased
For Existing Crossley Presses

COMPLETELY AUTOMATIC GRINDER FOR ALL TYPES OF CERAMICS

- Positive indexing infeeds for both heads
- Piece is easily clamped and held in stationary position
- Will grind two parallel surfaces at the same time
- Push-button control
- Positive alignment of heads
- May be used as a single or double head grinder
- Greater rigidity
- Low in cost
- One man may operate a number of machines
- Adjustable feeds and traverse
- Simple to operate
- Four-way movement of head to grind around a projection
- Rapid traverse of both heads in both directions to and from grinding area
- No chipping or damaging of piece due to excessive pressure



THE CROSSLEY MACHINE COMPANY

Trenton 9, New Jersey

CONTINENTAL SILICA COMPANY

SOMONAUK, ILLINOIS

Telephone: Somonauk 2732

CONTINENTAL Ground Flour and Flint MAXIMUM PURITY- GREATEST WHITENESS

Continental Silica's deposit of 396 acres with over 32 million tons of ultra pure, white silica sandstone of the St. Peter formation is located at Millington, Illinois. It is the nation's finest as the following characteristics prove:

PRODUCT CHARACTERISTICS

SiO ₂	99.9%
Fe ₂ O ₃	0.012%
Colormetric test	83.5
AFS fineness	36-152
Fusion Point	3198° F
Sintering Point	3057° F
Krumbein Roundness Chart	0.7—0.9
AFA Clay content	0.05%

A BETTER FINISHED PRODUCT FOR GLASS—CERAMIC MANUFACTURERS

Continental Silica Company sands will range in Fe₂O₃ content from 0.012 to 0.020. SiO₂—99.9% Colormetric tests on ground flour and flint show a reading of 83.5, unmatched whiteness. Continental will grind 6 to 8 grades of flour and flint ranging from 80 mesh to 400 mesh. Shipment in both bulk and bagged form.

Note these CONTINENTAL FEATURES:

- Special processing to protect purity
- Static filtering
- Dynamic blending
- New drying design
- Laboratory testing
- Precision screening
- Controlled flour bagging

NEW PLANT

Ultra-modern processing plant now under construction.
Deliveries scheduled for early 1959.

FREE TEST SAMPLES

We invite you to ask for FREE samples for your checking and testing.

Write today
for
FREE BOOKLET!



CONTINENTAL SILICA

DENISON ENGINEERING DIVISION

AMERICAN BRAKE SHOE COMPANY



1149 Dublin Road

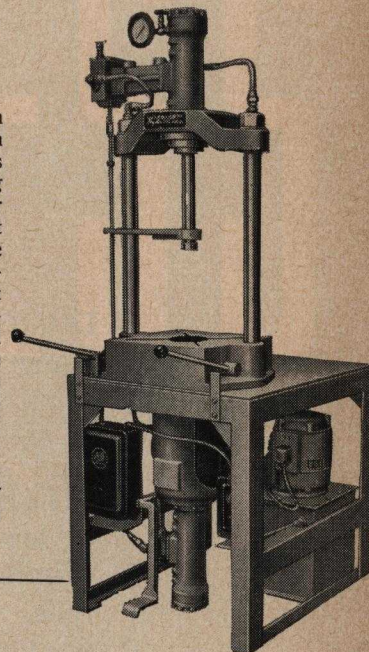
Columbus 16, Ohio

For more than twenty-five years Denison has specialized in designing, building and installing standard and special presses and general oil-hydraulic equipment to meet the specific needs of many of the largest ceramic plants in the United States. HydrOILics means more than just oil-hydraulic power. It means smooth, ample, flexible power, under exact automatic or manual control . . . whether that power be applied to the simple movement of a ram, or to a complex problem combining precision power control with closely regulated speed and movement of materials. Investigate Denison HydrOILic Equipment, as it may be profitably applied to your ceramic processes!

CERAMIC PRESSES

2 to 8 ton—2 strain-rod type

The 8-ton, 2-strain-rod ceramic press shown is equipped with a dual pumping unit which provides individual power for both the press ram and knock-out ram. By incorporating this feature of double-end pressure, greater control of density throughout the entire part is achieved. Provision has also been made for "bumping" via automatic vibratory repeat strokes which may be regulated to fit the particular job needs. This press has a 20-inch clearance between the 2 strain rods and a maximum of 25-inch clearance between the T-slotted bolster and the end of the ram thus allowing ample room for large dies and die-filling operations. Maximum stroke length of this press is 12 inches. Where individual requirements call for a press of different specifications, tell Denison of the need. They may have the right unit, or be able to furnish you a special unit.



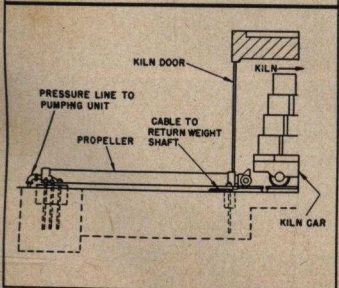
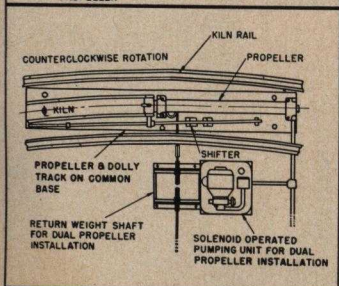
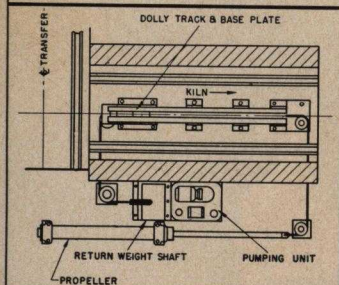
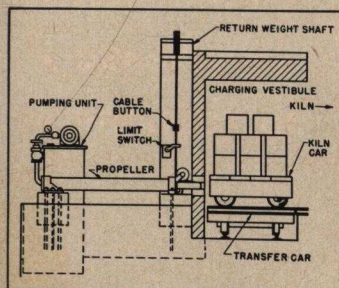
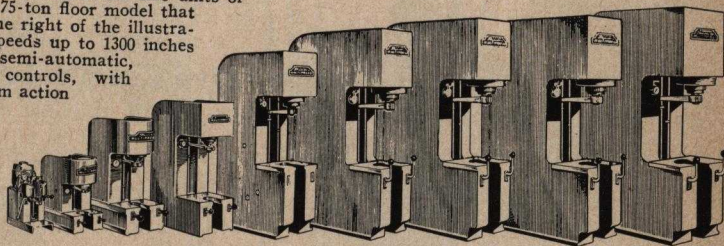
MULTIPRESS

The tailor-made answer to every press need—in the 1-to-75-ton range—is substantially what Multipress offers. Available in a complete range of sizes, it affords the advantages of special-built equipment at lower cost! Operating and control features are widely interchangeable.

Frame sizes range from small bench size units of 1-ton capacity to the 75-ton floor model that you see at the extreme right of the illustration at right. Ram speeds up to 1300 inches per minute. Manual, semi-automatic, or fully automatic controls, with almost any type of ram action desired.

Multipress also gives you the advantages of a complete line of standard accessory

equipment, such as knockout or ejection cylinders, pelleting attachments, hopper feeds, etc. If Multipress cannot be adapted to your needs, Denison engineers are prepared to design standard or special ceramic presses, such as the typical unit illustrated above.



Denison also offers a complete line of hydraulic pumps, controls, fluid motors and pumping units for the ceramic industry.



Illustrating the general construction of a Denison Car Propeller.

Denison pioneered the hydraulic car propeller and for over 25 years Denison Units have been the Kiln Builders' choice. Built in vestibule type, two and four-dolly under car types, under car pushers for circular kilns, and all other popular types, there is a job and time-tested Denison Unit available for every requirement. High-

Denison, Denison HydrOILics and Multipress are registered trademarks of Denison Engineering Div., ABCSO.

DOMINION MINERALS

Division

RIVERTON LIME AND STONE CO.

Telephone 2411

PINEY RIVER, VIRGINIA

Pioneer Producers of APLITE 19th Year

DOMINION APLITE is a dependable source of alumina ideally adapted for use in the manufacture of **glass products**. It is low in cost and is transported on the basis of low rail freight rates.

DOMINION APLITE is also used in the manufacture of **heavy clay products**, as a bonding material in **grinding wheels**, used in the manufacture of **welding rods**, and also in the production of other **Ceramic products** including **tile, terra-cotta, porcelain**, etc.

Your inquiries and orders are solicited.

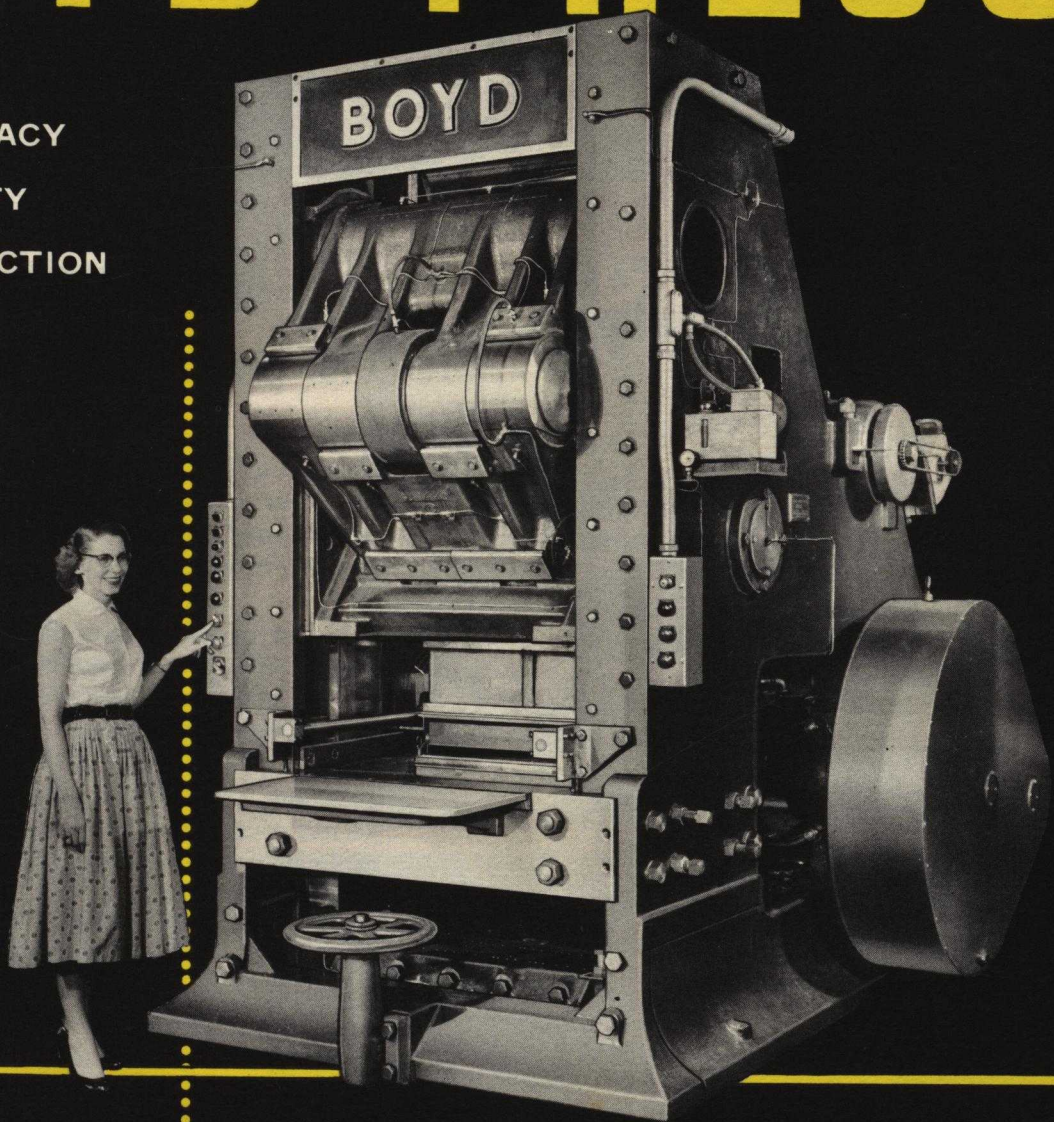
A representative Chemical Analysis follows:

Silica, SiO_2	60.00%
Alumina, Al_2O_3	23.75
Ferric oxide, Fe_2O_3	.30-.45
Titania, TiO_2	.06
Calcium, CaO	5.75
Magnesia, MgO	.10
Phosphorus pentoxide, P_2O_5	.05
Soda, Na_2O	6.00
Potash, K_2O	3.45
Ignition loss	.54

DOMINION APLITE IS UNIFORM IN CHEMICAL COMPOSITION
AND PARTICLE SIZE FROM SHIPMENT TO SHIPMENT.
FINENESS PRODUCED TO CUSTOMER'S SPECIFICATIONS

THE BOYD PRESS

- ACCURACY
- DENSITY
- PRODUCTION

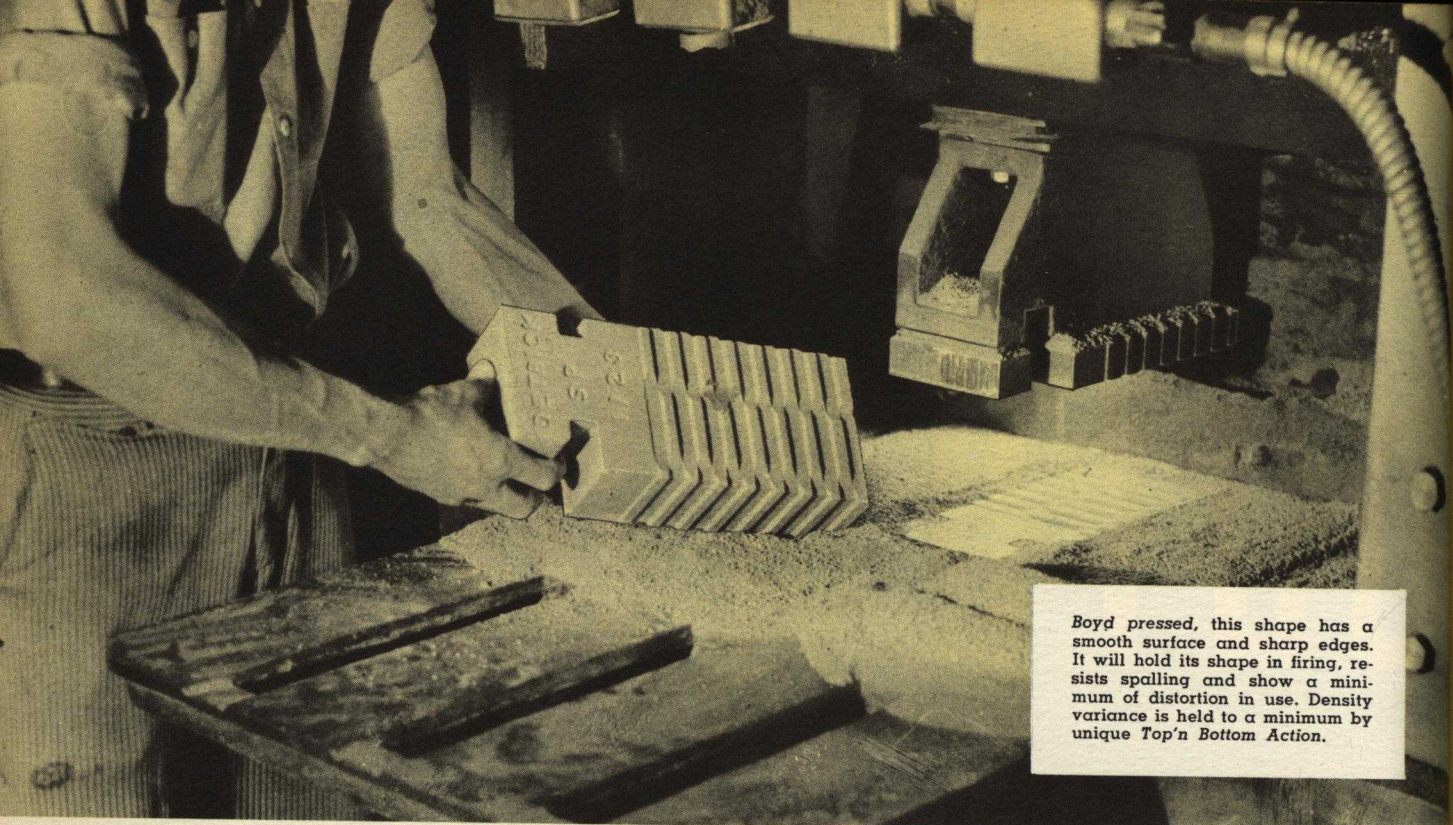


PUT BOYD PRESS IN YOUR

BLEUPRINTS FOR EXPANSION

CHISHOLM, BOYD & WHITE COMPANY

CHICAGO 21, ILLINOIS



Boyd pressed, this shape has a smooth surface and sharp edges. It will hold its shape in firing, resists spalling and show a minimum of distortion in use. Density variance is held to a minimum by unique Top'n Bottom Action.

(Photo: courtesy of Mexico Refractories Co.)

BOYD PRESS :

... intense controlled pressure for profitable dry pressing

Constant research and engineering advancements continue to make today's Boyd Press the logical choice for profitable, high volume production of dry pressed materials.

Since 1888, the Boyd Press has been regarded as "standard for the industry"—largely because its design and performance capacity has been kept up to date with industry requirements. Evidence of this reputation is found in the fact that *every leading manufacturer of dry pressed refractories in the U.S. relies on the Boyd press.* And over 95% of the dry pressed refractories made in this country are produced on Boyd Presses.

... You don't build a press with History

The contents of this bulletin bear out this statement. On the following pages are outlined some of the principal improvements made to the Boyd Press in recent years. Included are specifications, capacity data and details about outstanding advantages of the *Best Boyd Yet*. Here is what they mean to you:

You Buy Boyd with Confidence. The Chisholm, Boyd & White Company builds brick presses. The production of more and better refractories is as much our goal as it is yours. With the Boyd

Press you take advantage of what we know about the compaction of granular materials in general, and about building machinery for refractory brick in particular.

Increased pressures. New bearings, new clutch design, new rugged toggles and heavier frames permit greatly increased operating pressures with lower maintenance.

Automatic Control. "Boydomatic" controls now permit greater flexibility and much greater control over press operating cycles. Because of this flexibility of control, you can now produce shapes on the Boyd Press that were thought impossible — a few years ago.

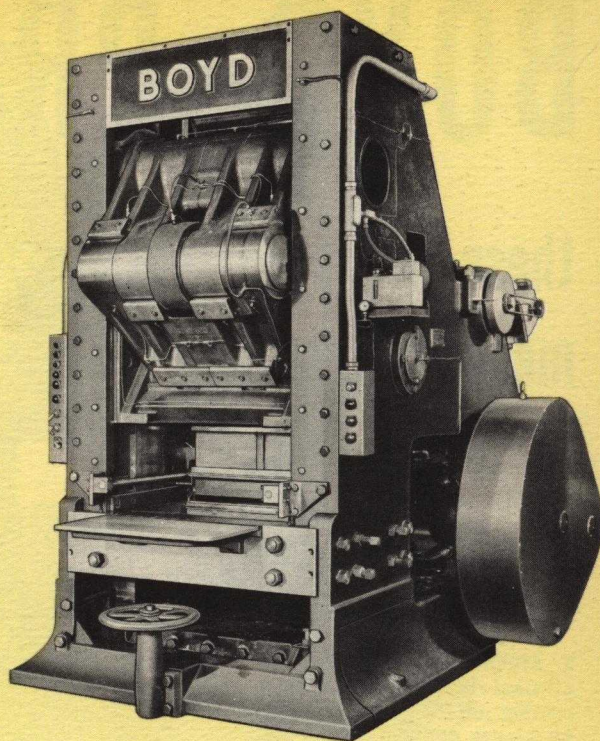
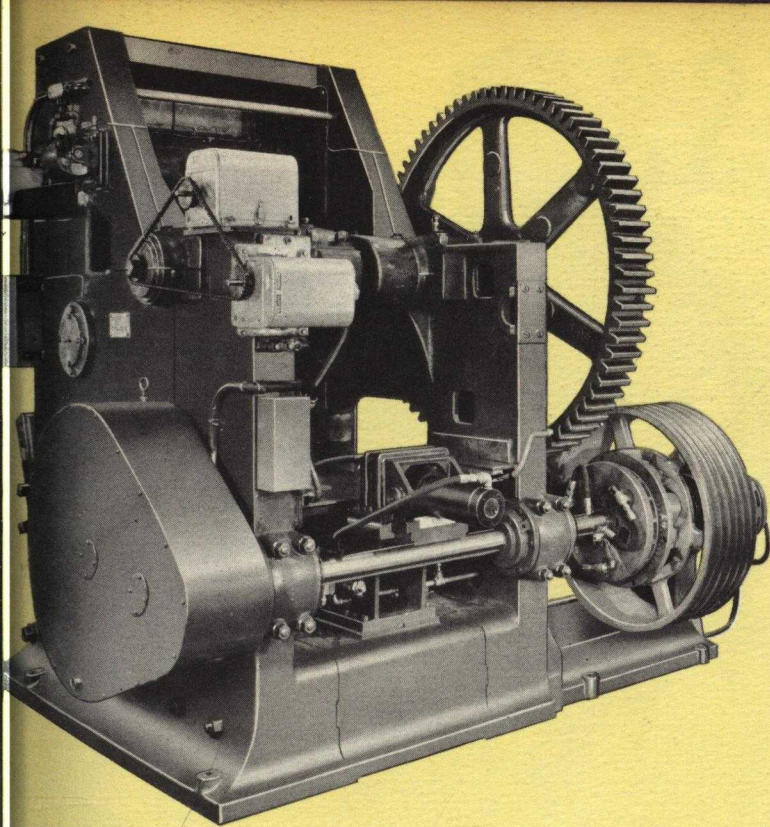
Selectivity. *Two* models of the Boyd Press are now in regular production. The Model X — reliable favorite of the industry and the new, redesigned, Model Y press are both described here.

Wear parts replaceable. More wearing surfaces and parts are now replaceable on the Boyd Press. This means less time lost in production and you can realize faster, more economical repairs and maintenance.

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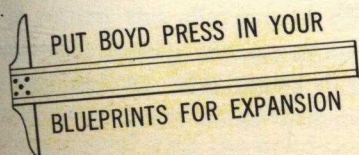
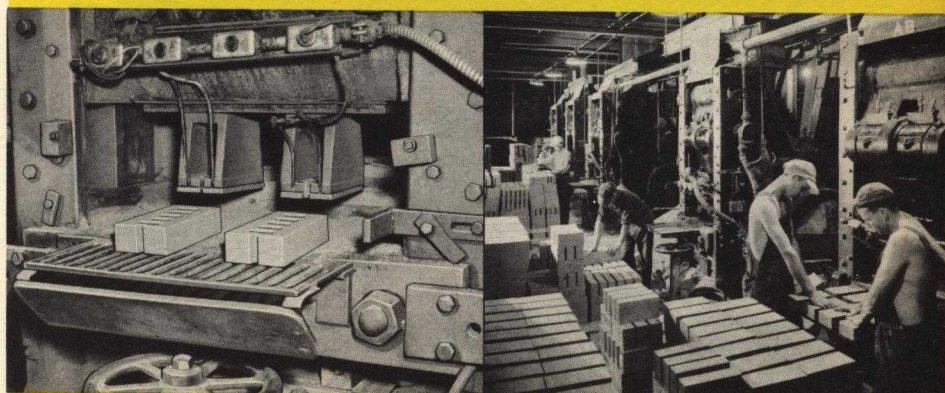
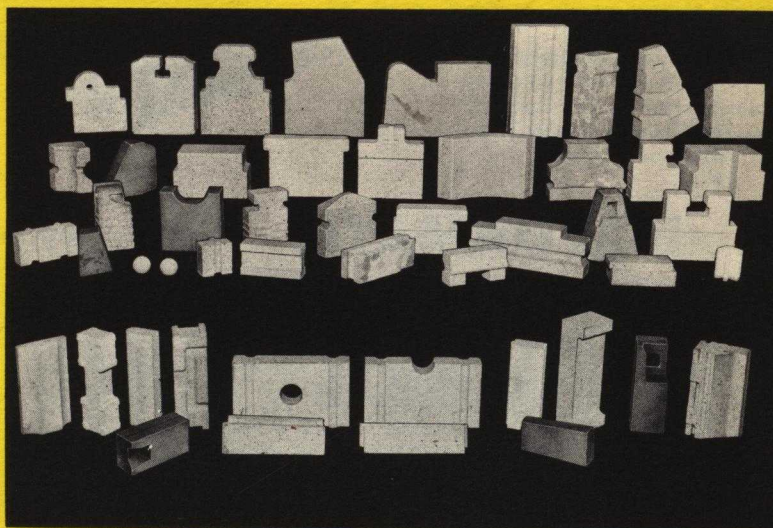


Better, more stable shapes with dry pressed refractories

Dry pressed refractory bricks have a better, more stable structure than refractory shapes produced by any other means. Surfaces are smooth, edges are sharp and you get better control over moisture — to alleviate drying problems. You can set brick directly on the kiln car as it comes from the dry press. The formed bricks hold their shape through firing, show a minimum of distortion in use and withstand temperature changes with a minimum of spalling.

Variety of shapes possible

The photo at right indicates just a few of the wide variety of special shapes that can be handled, with care, on the Boyd Press. Liners, dies and all mold equipment for shapes such as these are another part of the better-than-ever service you get when you:



DRY PRESSED SCR brick. Fast firing schedule is handled by the Boyd Press at Seattle, Washington plant of Gladding McBean Company.

HIGH ALUMINA refractory brick is loaded on kiln cars. Boyd Press is ideal for such high density brick.

(Photo courtesy Mexico Refractories Co.)

BOYD PRESS:

these improved features
mean better brick
at lower costs

1. NEW BEARINGS. High speed shafts are fitted with sealed roller bearings, low speed shafts with renewable plastic inserts.

2. STRONGER TOGGLES are of all steel rib construction. Load bearing surface increased 100%. All bronze or steel bearing surfaces are replaceable with interchangeable parts.

3. HEAVIER FRAMES increase pressure potential. Larger journals and extensive ribbing increase rigidity of press.

4. HEAT TREATED alloys and flame hardened journals make gears, crankshaft, side bars and crosshead tougher, longer wearing and smoother running.



BOYDAMATIC

Boydamic control features give the Boyd Press

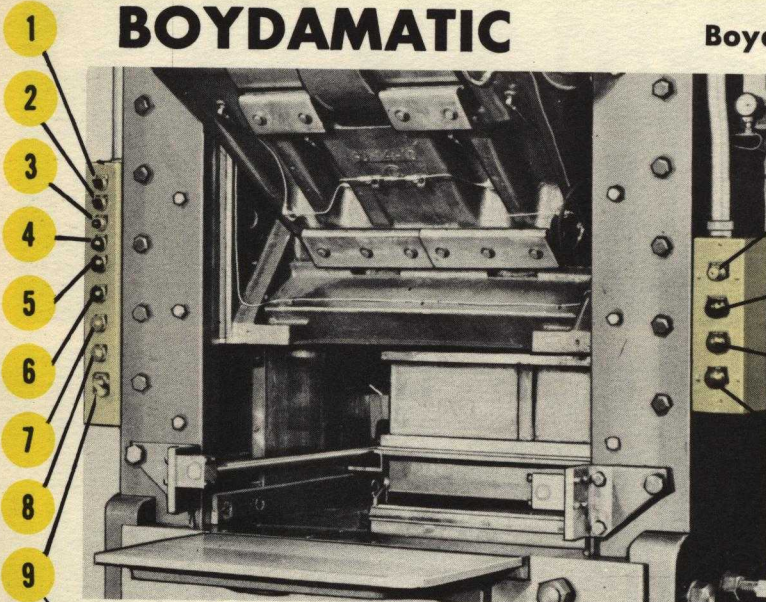
In addition to features described here the control system can be arranged to meet customer's special requirements for the "tie-in" of additional equipment. The photo shows the arrangement of the panel. Here's how it works:

"OFF" — when the switch is in the *Off* position, the brake is engaged, and the clutch is disengaged.

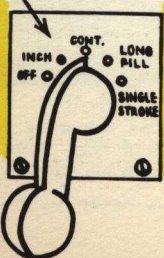
"INCH" — when the switch is in the *Inch* position, the press will start when the *Inch-Start* button is pressed. The press continues to operate until the button is released.

"CONTINUOUS" — when the selector switch is set in the *Continuous* position and the *Inch-Start* button is pushed, press continues to operate until the *Stop* button is pushed.

The *Single Stroke* cycle is used for semi-automatic production of special shapes when formed brick must be removed by



Selector Switch Positions:



- | | |
|------------------|--------------------|
| 1. Test Charger | 8. Stop |
| 2. Pause | 9. Selector Switch |
| 3. Oil Indicator | 10. Dual Control |
| 4. Air Supply | 11. Charger—Out |
| 5. Charger—Out | 12. Start—Inch |
| 6. Charger—Back | 13. Stop |
| 7. Start—Inch | |

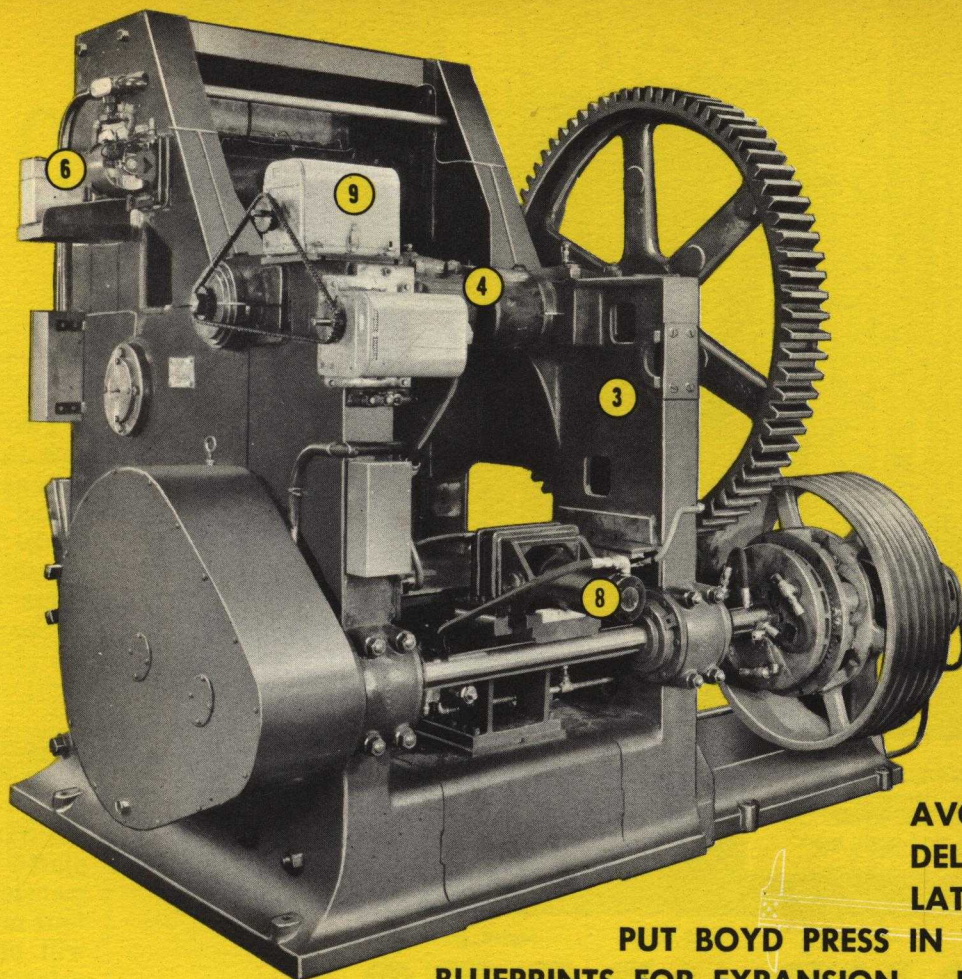
END GRAIN FORMICA is used for frame wear plates. Is non-"galling", durable, smooth and easy to replace.

AUTOMATIC FORCE-FEED LUBRICATION is positive, thorough. Takes element of human labor out of routine maintenance press.

AIR OPERATED CLUTCH-BRAKE gives instant response to control. Is positive, heavy duty and trouble-free.

AIR OPERATED CHARGER provides new flexibility. Can be arranged to operate continuously with press motion or independent of press motion. (Model X press can be furnished with mechanically operated charger).

"BRAINS" for the new flexibility of the Boyd Press is found in this sequencing rotary cam unit switch.



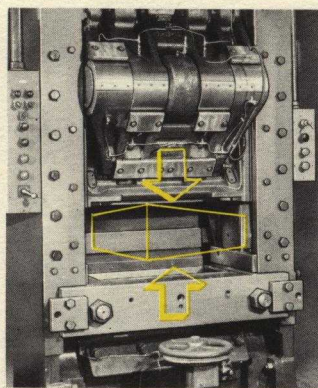
**AVOID
DELAYS
LATER...**

**PUT BOYD PRESS IN YOUR
BLUEPRINTS FOR EXPANSION...NOW!**

widest possible operating range.

and, or when portions of the mold must be fastened to the lower punch. The *Single Stroke* cycle is also used when bricks are pressed inside a steel case. Time must be allowed for placing the case in the mold before the mold is filled with the mix. In the *Single Stroke* cycle, the press stops automatically at the end of each cycle.

When the selector switch is set in the *Single Stroke* position, and the *Inch-Start* button is pressed, the press automatically stops when the bottom die plate is level with the mold table. After a time interval that may be adjusted, the bottom die plate automatically drops to its selected position for proper fill. The operator then pushes the *Charger Out* button to bring out the air-operated charger. When the mold has been filled, he pushes the *Charger Back* button to return the charger to its original position. He starts the press by pushing the *Start* button. The press then repeats the cycle, again stopping when the bottom die plate is level with the mold table.



TOP'N BOTTOM ACTION

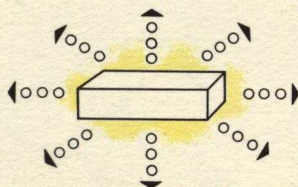
... cuts density variance to minimum

One of the unique features of the Boyd Press ... a feature that has made this press outstanding in its field ... is that pressure is exerted upon both the top and bottom of the material being pressed. This is possible because the members supporting the upper plungers are connected, through side bars, with the members supporting the lower plungers.

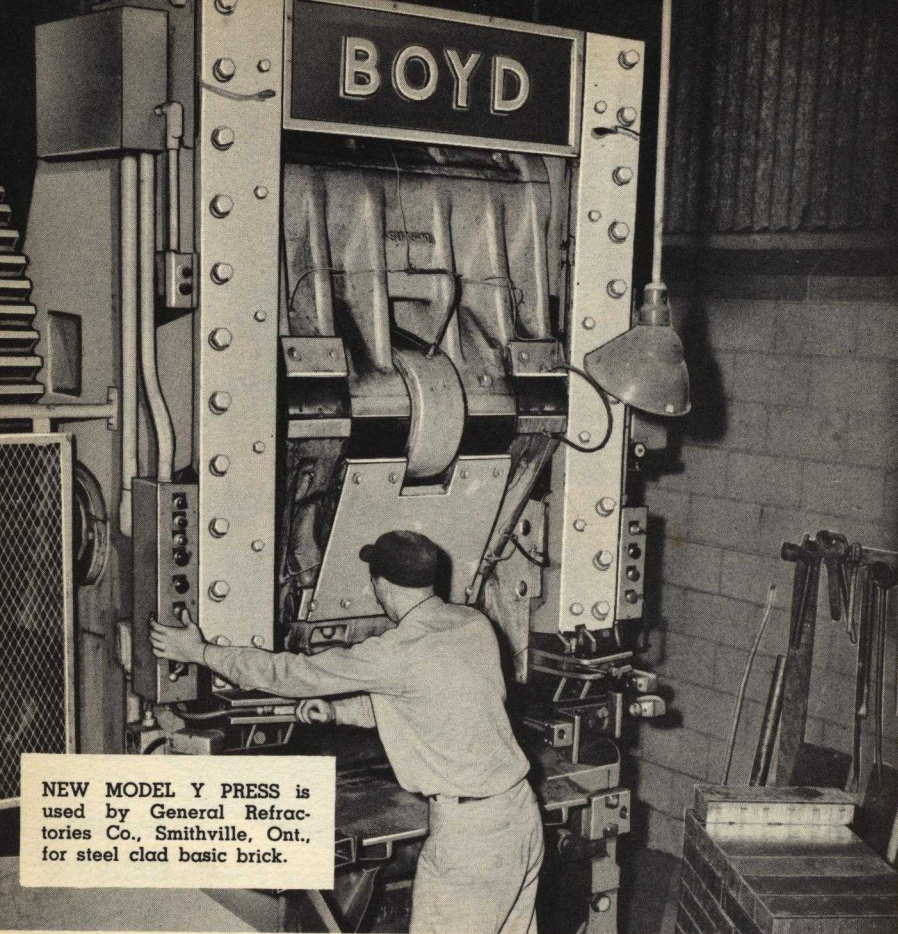
This design keeps variations in density from top to bottom of the formed material to an absolute minimum. The Boyd Press thus overcomes one objectionable feature of brick produced on a single acting press.

AUTOMATIC DEAIRING PAUSE

... makes full use of pressure possible with the Boyd Press

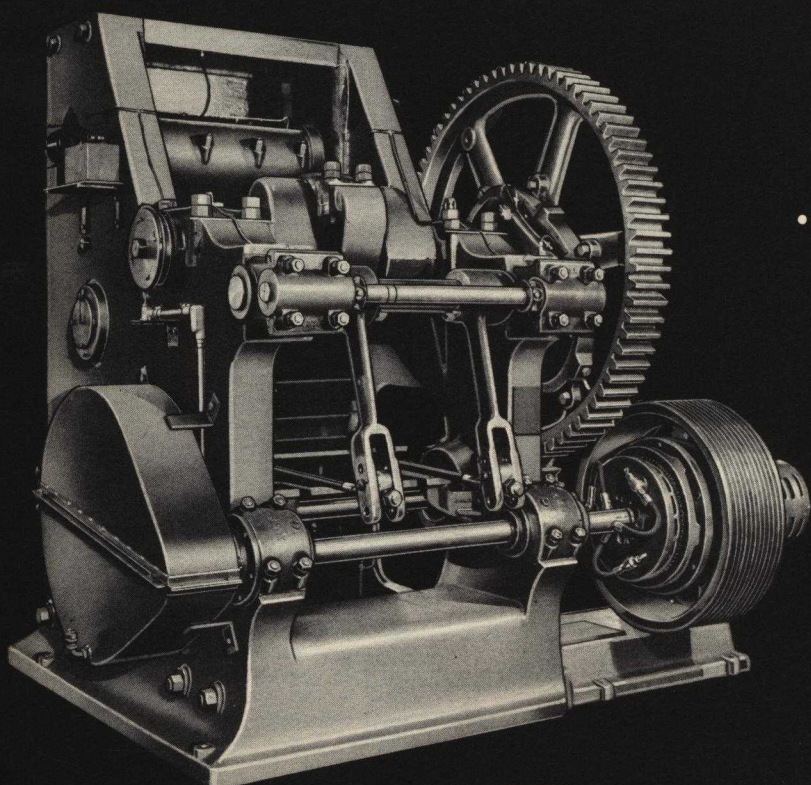


A momentary pause in the press operation permits trapped air to escape from the partially compressed material. Mix is then better oriented for final compression stroke. The shape will show less distortion in firing and use and will better resist temperature change and spalling. "Pause" is fully automatic, fast and trouble-free. "Pause" can be used either in or out of the *Single Stroke* or the *Continuous* position of selector switch.



NEW MODEL Y PRESS is used by General Refractories Co., Smithville, Ont., for steel clad basic brick.

BOYD PRESS:



MODEL X

Also available with Mechanical Charger

Two models of the Boyd Press are now in regular production. Specifications and dimension data for the Model X and the new heavy-duty Model Y press are shown here. Both presses are equipped with all of the latest design improvements shown on the previous pages.

PRODUCTION

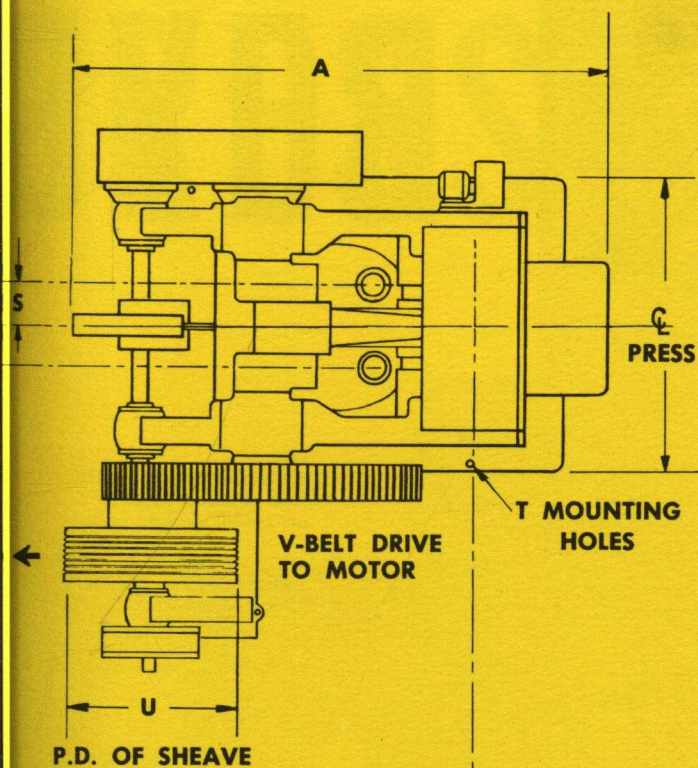
Normal operating speed of the Boyd Press is eight strokes per minute. Production output is based upon the number of molds which can be placed in the mold cavity. (See dimensional data.) For example, when four molds are used a Model X Press will produce about 1,920—9"x4½" refractory bricks per hour.

PRESSURES

The normal operating pressure of the Model X Press is 400 tons. For the Model Y it is 800 tons. Required pressures will, of course, vary depending upon factors such as; plasticity of materials, density and moisture content and screen analysis.

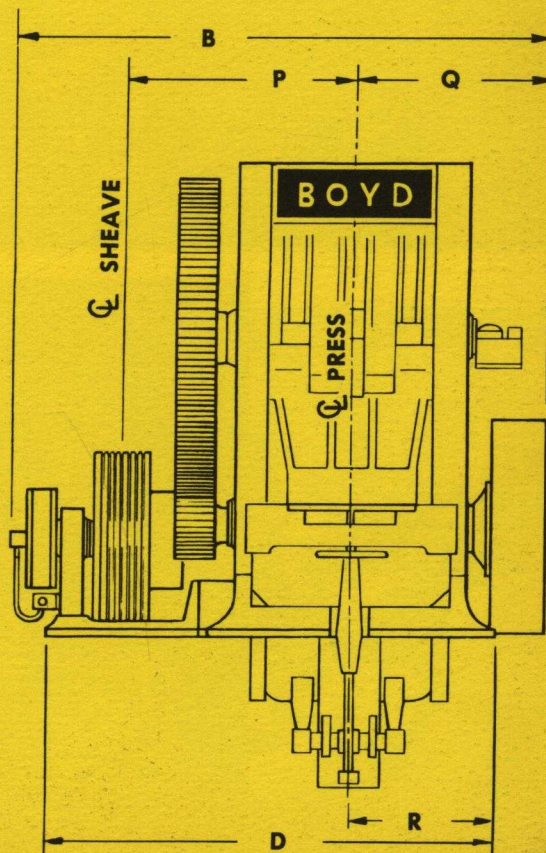
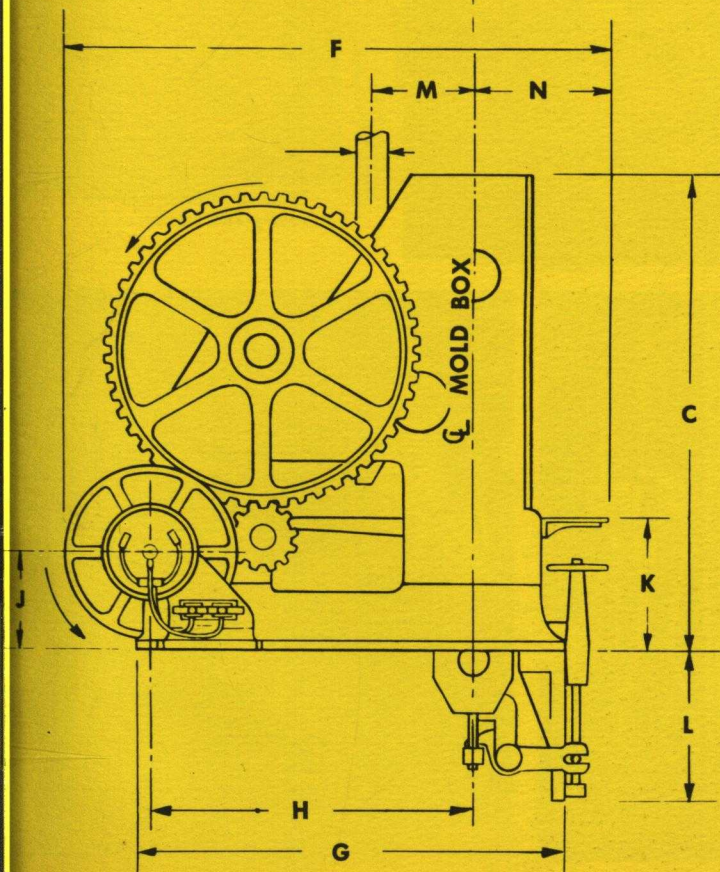
The Model X Press can be furnished with a mechanical charger operated by a cam and follower arrangement (see left). This charger cannot be operated independently of press motion. However, press controls provide for *inching*, *continuous* and *single stroke* operation. In the *single stroke* position the press shown here will stop when the brick is free of the die—and will not start again from the position until the *start* button is pressed.

SPECIFICATIONS



Dimension:	Model X	Model Y
A	10'- 0"	11'- 6 3/4"
B	9'- 11 1/2"	11'- 10"
C	8'- 10"	10'- 6 1/2"
D	8'- 5 1/4"	9'- 10 1/2"
E	6'- 3 1/4"	6'- 4"
F	9'- 6"	11'- 11 3/4"
G	6'- 10"	9'- 4 3/4"
H	5'- 2 5/8"	7'- 1 5/16"
J	2'- 3 1/2"	2'- 1"
K	2'- 10 1/2"	2'- 11 1/4"
L	1'- 8 3/8"	3'- 1 1/16"
M	1'- 7 1/2"	2'- 3 1/4"
N	2'- 7 3/8"	2'- 11 1/2"
P	4'- 1 11/16"	5'- 0"
Q	3'- 4"	4'- 2 1/2"
R	2'- 7 5/8"	3'- 2"
S	9"	11"
T	7"	6"
U	36"	45 1/4"

Mold Cavity	29 7/8" x 16" x 9" deep	37" x 20 3/4" x 12" deep
Motor Required	25 HP	50 HP
Press Weight	38,000 lbs.	77,000 lbs.
Drive Shaft RPM (for 8 strokes per minute)	185.7	195
Drive Shaft grooved for "V" Belts	10 "C" Section	7 "D" Section



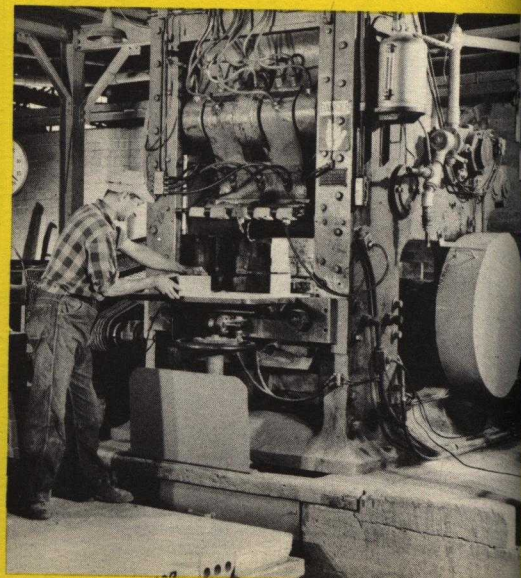
BOYD



Left:
MEXICO REFRACTORIES
here produces *high*
calcline 9" straight brick.

Below:
HARBISON-WALKER
Plant uses Model X on
rotary kiln blocks.

Right:
ELGIN BUTLER BRICK CO.,
Elgin, Texas, used Model
X for producing Rock
Faced Roman Building Brick.



PRESS:

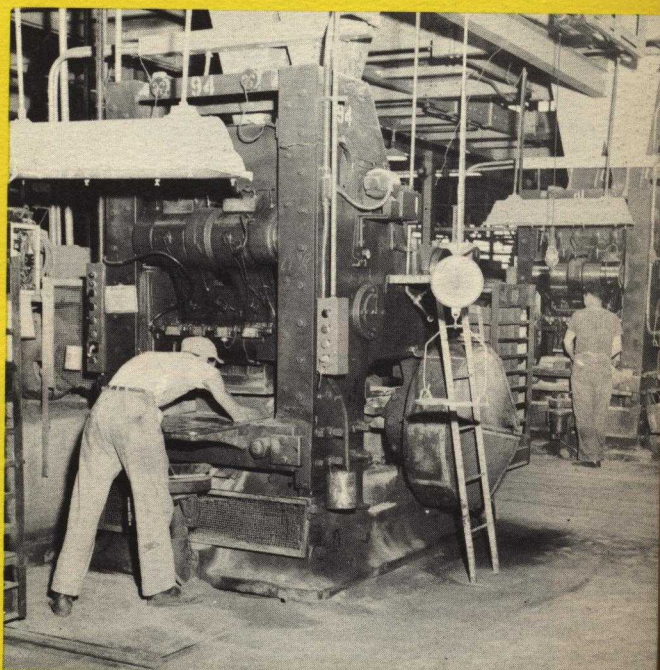
- Serving every leading refractory producer
- Producing 95% of dry press brick in U.S.

As industry needs become more specialized, the demand for precise dimensional control and the intricate shapes possible only through dry pressing have increased similarly.

Typical examples of the manner in which leading producers are using the Boyd Press to meet these needs are shown here.

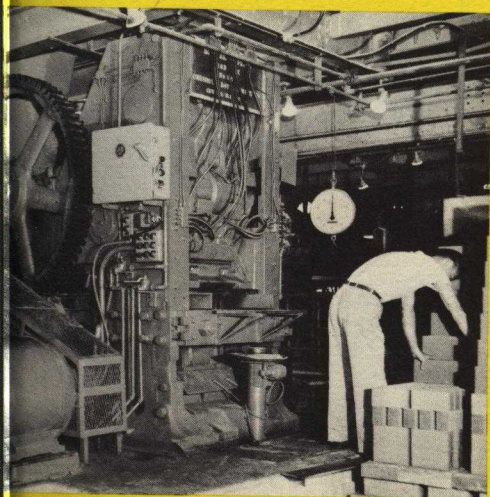
Right:

E. J. LAVINO & CO.
Norristown, Pa., added
Boydomatic controls to
this Model X press to
speed production of large
basic wedges.



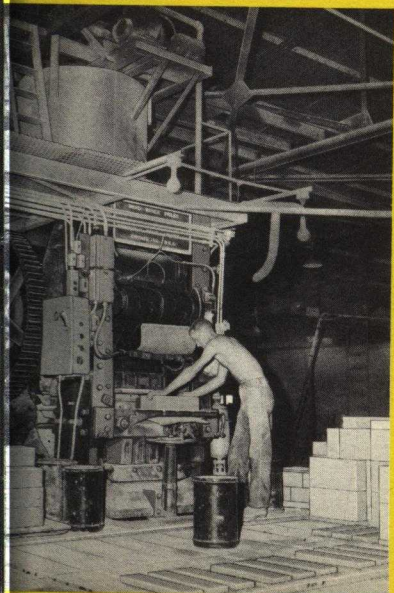
Left:

SILICA BRICK being
produced on a Model X
press at Harbison-
Walker, Windham, Ohio
plant.



Below Left:

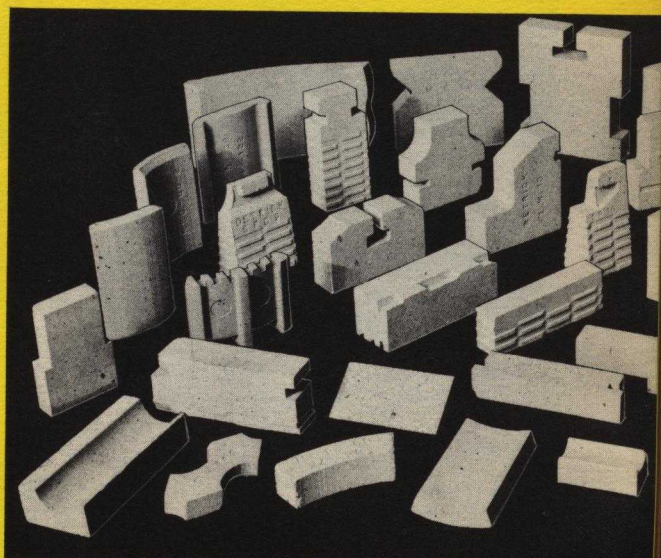
**WELLSVILLE FIRE BRICK
COMPANY,** Wellsville,
Missouri, turns out large
refractory shape on
Model X.

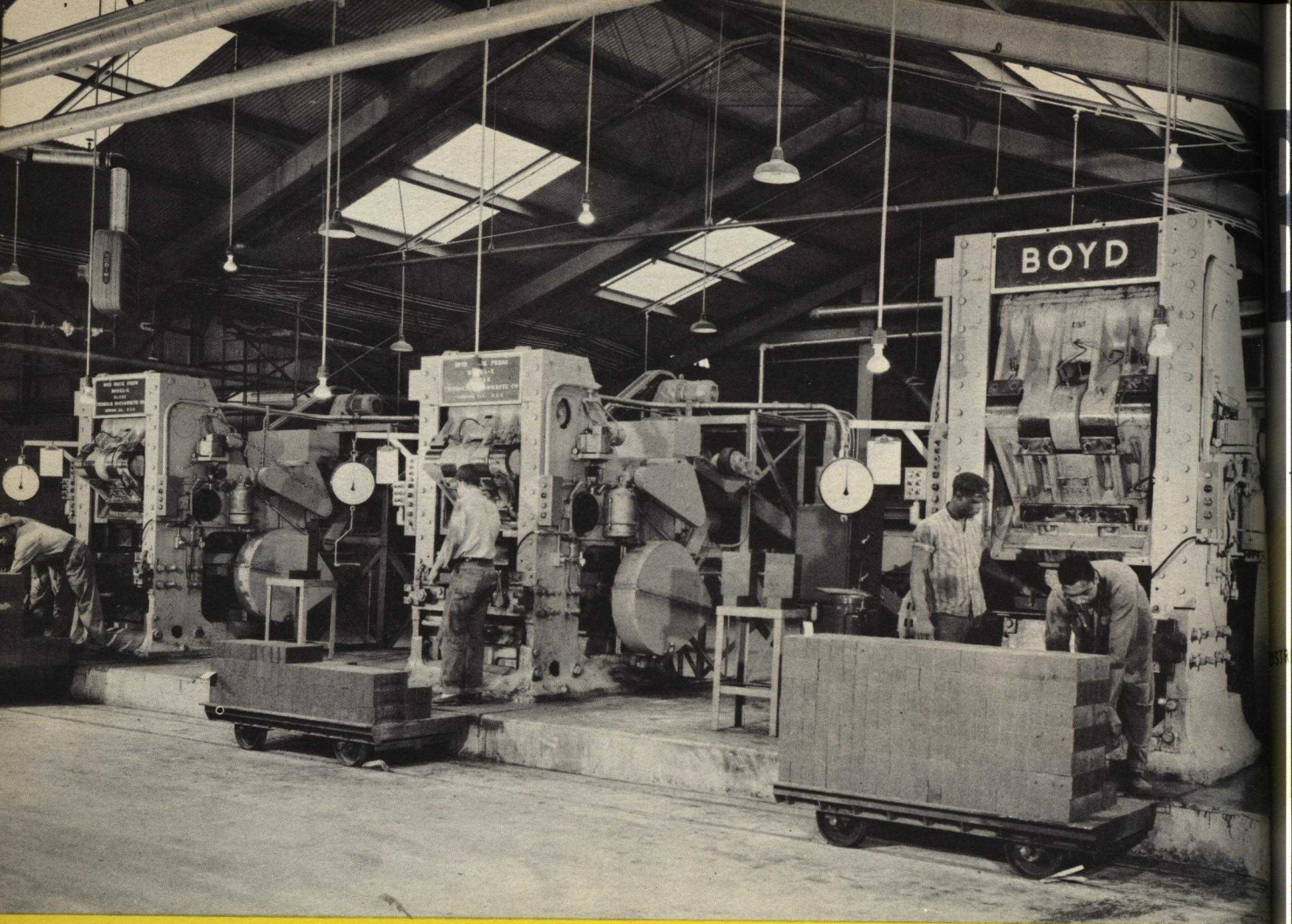


MOLD EQUIPMENT

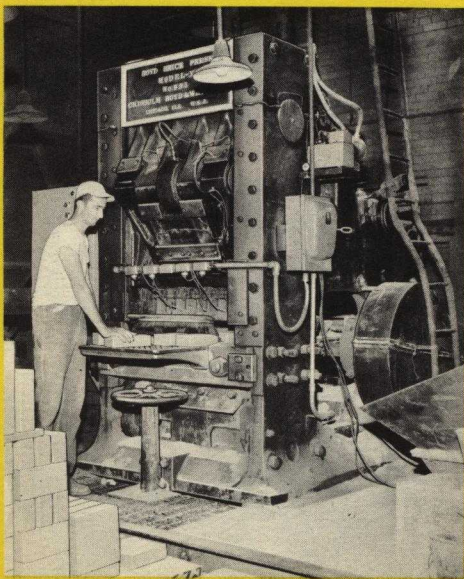
CB&W designs and manu-
factures dry press liners, dies
and all mold equipment. Let
us help you with your needs
for this equipment. Write for
details.

PUT BOYD PRESS IN YOUR
BLUEPRINTS FOR EXPANSION

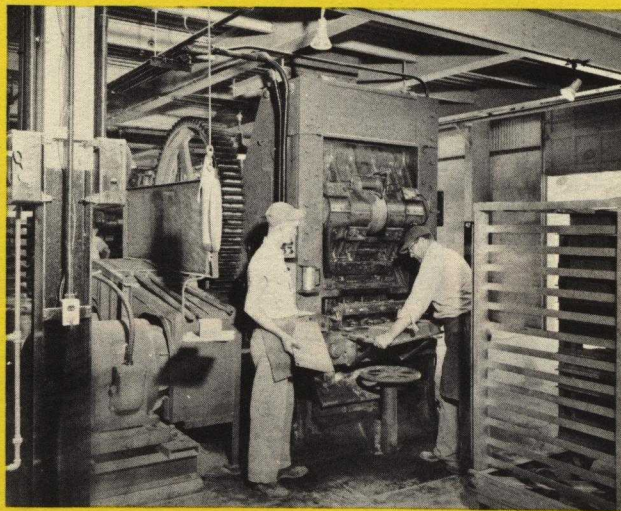




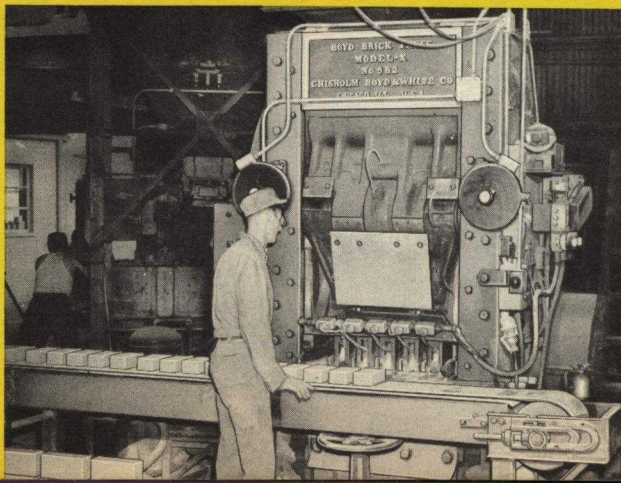
Above:
SECTION OF PRESS DEPARTMENT at new Harbison-Walker plant in Hammond, Indiana. Shown are two Model X and a new model Y Boyd Press.



Above:
WALSH REFRACTORIES CORP., Vandalia, Mo., uses Model X for producing 9" x 4½" high alumina refractories.

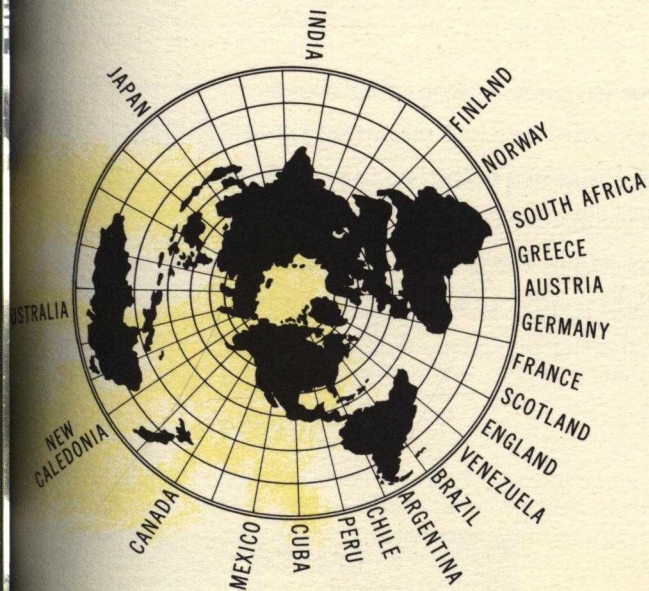


Left:
HARBISON-WALKER, Leslie, Md., produces 9" straight silica refractories on Model X.



Left:
DETROIT BRICK & BLOCK CO. This Model X is used to press sand-residue building brick. Note conveyor to carry brick from press.

BOYD PRESS:

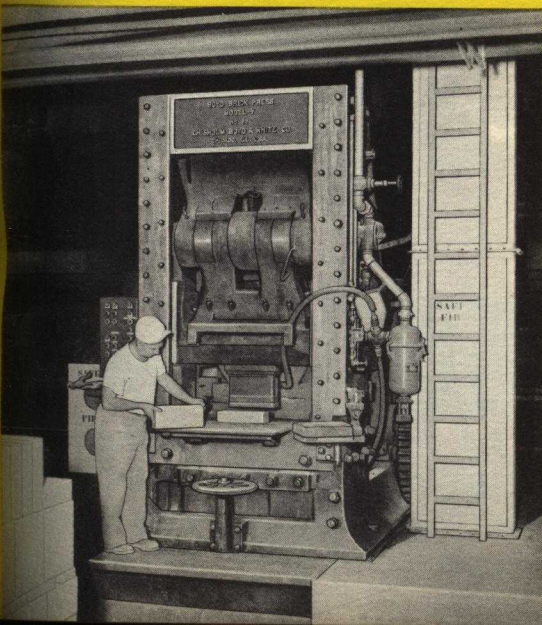
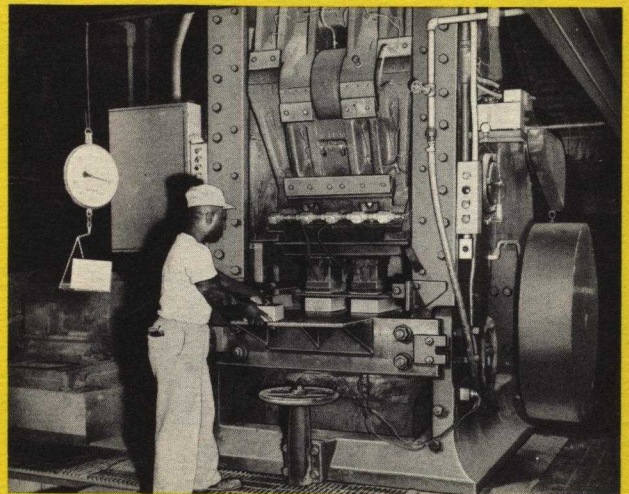


... In service throughout the world

Boyd Brick Presses are in service throughout every continent in the world. Their ability to serve the variety of compaction requirements shown on these pages continues to make Boyd Press the first choice . . . the *right* choice everywhere!

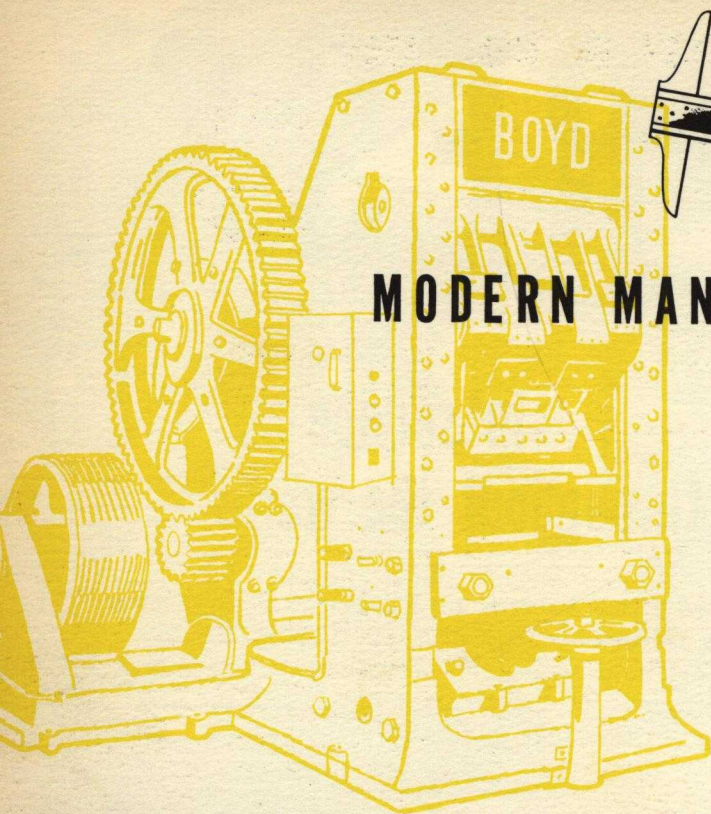
Right:
HARBISON-WALKER,
Bessemer, Ala., uses this
new Model Y press for
high production of high
calcine brick.

Below:
A. P. GREEN FIREBRICK CO.
uses Model Y press on high
calcium refractories.



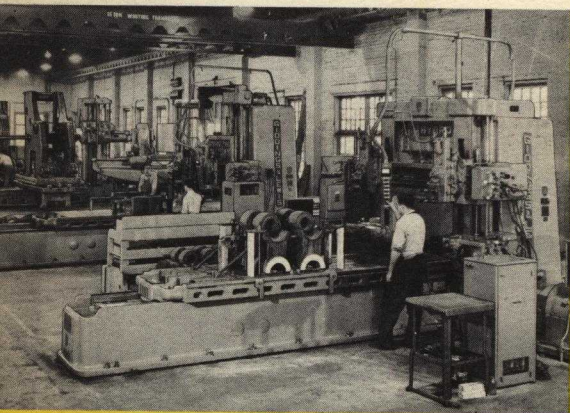
Modernize
Your
Old BOYD
PRESS

All of the improvements shown on pages 4-5 of this bulletin are available to give you longer, better service from your present press. Write for details on how you can add: Boyda-matic, new, stronger toggles; improved bearings; force-feed lubrication, etc.

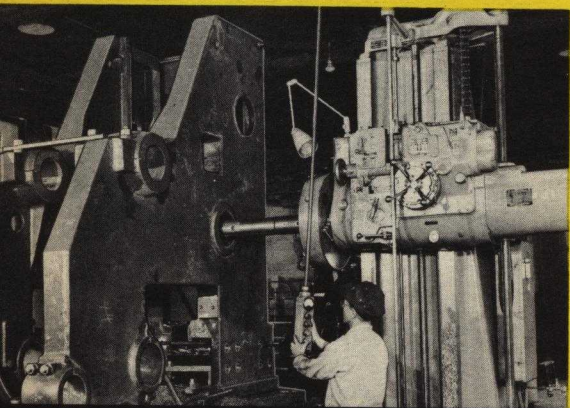
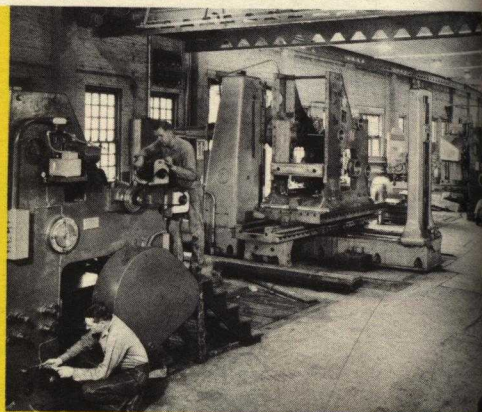


MODERN MANUFACTURING FACILITIES

Major expansion of our facilities to design, engineer and manufacture the Boyd Press has helped us to provide *you* with assurance that your next Boyd Press will be the most modern and efficient compaction machine ever built.



◀ Press assembly line shows ▶ extensive machining facilities that back up Boyd Press. New, modern machine tools insure precision tolerance in the press to provide you with facilities to produce a better, more stable product.



◀ Whole Press Frame rests on bed of this Giddings & Lewis Boring Mill.

You are Invited to inspect ▶ the Boyd Press at our Chicago plant where our engineering facilities are at your service.



CHISHOLM, BOYD & WHITE CO.

610 WEST 57TH STREET • CHICAGO 21, ILLINOIS

Cable Address: "BOYDPRESS"

Telephone: WEntworth 6-0922

boyd
BRICK
PRESS

B. F. DRAKENFELD & CO., INC.

EXECUTIVE OFFICES

45 Park Place
New York 7, New York
Phone: BARclay 7-6810
TWX Teletype: NY 1-1188

FACTORY AND RESEARCH CENTER

West Wylie Avenue
Washington, Pennsylvania
Phone: BALdwin 5-5600
TWX Teletype: WASH PA 278

SINCE



1869

PACIFIC COAST AGENTS

BRAUN CHEMICAL COMPANY
1363 South Bonnie Beach Place
Los Angeles 54, California
Phone: ANgelus 9-9311

BRAUN-KNECHT-HEIMANN COMPANY
1400 Sixteenth Street
San Francisco 19, California
Phone: HEmlock 1-8800

COLOR SERVICE

Solving color problems pertinent to the Glass, Clay Wares and Porcelain Enamel Industries is one of Drakenfeld's most important functions. For we share the satisfaction customers express in the better quality products and more economical production our research helps them achieve. Our long experience in color engineering and manufacture, plus special methods and equipment, are aiding more glass, pottery, porcelain enamel, tile and heavy clay products companies every year.

COLOR PRODUCTION

Top-quality raw materials, rigid production controls and thorough laboratory tests enable us to supply high-uniformity colors that meet your specifications and have all the characteristics required by your particular methods of operation.

INQUIRIES INVITED

Learn how the skill and varied experience of our technologists can help you wipe out "color bugs," and to save time, materials and money. We welcome the opportunity to study your color problem and to recommend a practical solution.

GLASS COLORS

Acid, Alkali and Sulphide Resistant Colors
Beverage Bottle Labeling Colors
Colors for Table Tumblers

Screen Printing Colors in Drakotherm
Bent Glass Colors
Colors for Toilet and Cosmetic Bottles
Spray Colors

Satin Finish Colors
Matt Colors
Glass Stainers' Colors
Amber Stains
Crystal Ices

CLAY WARES COLORS

Glaze Stains
Body Stains
Prepared Glazes

Engobe Stains for Face Brick
Underglaze Colors

Overglaze Colors
Glaze Specks
Sand Colors for Brick

PORCELAIN ENAMEL COLORS

Base Oxide Colors
Blended Oxide Colors

Enamel Overglaze Colors
Graining Oxides

OILS AND MEDIUMS

Squeegee and Printing Oils
Spraying Mediums
Banding Mediums
Dipping Mediums

Sevco Gum (water soluble underglaze painting medium—no hardening on fire needed)

METALLIC OXIDES, COLORING CHEMICALS

Antimony Oxide
Arsenic, Glassmakers'
Barium Selenite
Cadmium Oxide
Cadmium Sulphide, Orange A
Cerium Hydrate
Cobalt Oxide
Copper Oxide, Black
Decolorizers, Glass
Didymium Carbonate
Iron Oxide, Black
Manganese Dioxides
Neodymium Carbonate
Nickel Oxides
Powder Blue
Selenium

SCREEN PRINTING SUPPLIES

Swiss Bolting Cloth
Monofilament Swiss Nitex
Silk Screen Photo Solution, Nu-Sol No. 1B

CONDUCTIVE COATING MATERIALS

Silver Paste for Printed Circuits
Silver Paste for Capacitors
Silver Metal Preparations for Brushing, Dipping, Spraying

SUPPLIES AND EQUIPMENT

Decalcomania Papers, Unprinted
Frosting Compounds for Glass
Pencils, Underglaze
Printing Tissues
Soap, Mouldmakers' Soft

YOUR PARTNER IN SOLVING COLOR PROBLEMS

Drakenfeld

THE DEISTER CONCENTRATOR COMPANY, INC.

The Original Deister Company—Incorporated 1906

Manufacturers of Vibrating Screens, Concentrating and Material Washing Tables, Classifiers

CONCENTRATOR
PRODUCTS

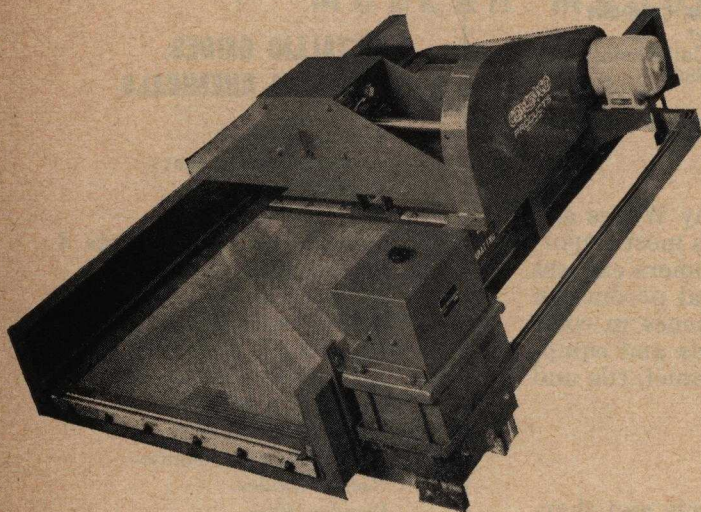
933 Glasgow Avenue, Fort Wayne, Ind.

CONCENTRATOR
PRODUCTS

Export Sales.....60 Beaver Street, New York 4, N. Y.
Pennsylvania Sales.....35 East Center St., Nesquehoning, Pa.
Alabama Sales.....2612 North 24th St., Birmingham, Ala.
Canadian Sales: Akela Ltd.....235 Speers Road, Oakville, Ontario

Forrest A. Paschal.....Siler City, N. C.
Robert A. Griffin.....220 25th St., N.W., Canton, Ohio
Walter C. Stoll & Sons.....5028 Alhambra Ave., Los Angeles, California
Adelman Machinery Co.....520 First Ave., South, Seattle, Wash.

OVER 50 YEARS EXCLUSIVELY ENGAGED IN THE MANUFACTURE OF SEPARATING AND SIZING EQUIPMENT



The LEAHY NO-BLIND HEAVY DUTY VIBRATING SCREEN may be equipped with FlexElex electric heating of the screen cloth.

FlexElex jacket heating is engineered especially for fine mesh screening of damp materials such as clays, shales, fine coal, pulverized limestone, ores, chemicals, etc. Thus is opened up an entirely new range of economic screening applications in these fields where previously good or practical performance could not be expected from conventional type vibrating screens.

A low voltage, high amperage electric current is passed through the screen cloth, causing it to heat sufficiently that wires are kept warm and dry. Without cold jacket wires, which invite the first phase of build-up by damp, dust-size fines, there can be no subsequent build-up for ultimate blinding.

Thus FlexElex jacket heating keeps the mesh wide open for free passage of screenable fines. When its advantages are added to the Leahy Screen's unblinding action for disposing of intermediate size particles, the result is an efficiency and capacity never before achieved in the screening field. Screening at any accustomed mesh, capacity is stepped up to a gratifying degree. On the other hand the same capacity may be maintained with smaller mesh openings formerly considered impractical.

On NEW LEAHY SCREEN EQUIPMENT, the FlexElex features, a part of the screen itself, are factory incorporated to permit easy and simple field erection of the screen and electrical accessories. FlexElex heating is actually integrated with Leahy screen design and construction and ready for line wiring.

For OLD LEAHY UNITS, already in the field, all FlexElex conversion items and apparatus, along with complete instructions, are furnished for simple and easy installation.

FlexElex®

ELECTRIC HEATING OF SCREEN CLOTH

(Patent applied for)

Available for NEW MODEL E OR OLD

Leahy® SCREENS

DESCRIPTION. The FlexElex electric jacket heating system for the average size Leahy screen comprises: a 15 KVA dry type, single phase transformer with line voltage primary and low voltage secondary, complete with switches and controls for closer adjustment of current and heat used; short, high capacity aluminum bus bars connecting transformer to contact bars at jacket, eliminating flexible cables or connections in the heating circuit. Highest electrical and thermal efficiency is assured by the most practical design of circuit through short runs of bus bars of generous cross section in laminated assembly with air gap spacing.

POWER REQUIRED. Three sizes of transformers, of 10, 15 or 20KVA rating are available. With the FlexElex system it is easy to regulate the current required to meet day to day or season to season operating conditions with optimum results at minimum power consumption.

SCREEN JACKET CHANGE TIME. Screen jackets are disconnected with the same ease as with conventional Leahy screens. Electrical connections are maintained through the bus and contact bars, and without flexible connectors. No make or break of the circuit is necessary. Furthermore, jackets need not be changed as often. Field experience shows that even with less expensive grades of cloth, the life of electrically heated jackets, requiring no beating or brushing, is several times that of unheated cloth.

OVERALL ECONOMICS. The elimination of attendants for cleaning screen cloth, the longer screen life, the reduced power consumption on the grinding circuit from less circulating load, and the stepped up full capacity production, all add up to savings that pay for the FlexElex equipment in less than a year's time . . . this after accounting for the entire cost of the extra power required to heat the cloth. Send for Bulletin 16-EH.

THE DEISTER CONCENTRATOR COMPANY, INC.

The Original Deister Company—Incorporated 1906

CONCENCO
PRODUCTS

Manufacturers of Vibrating Screens, Concentrating and Material Washing Tables, Classifiers

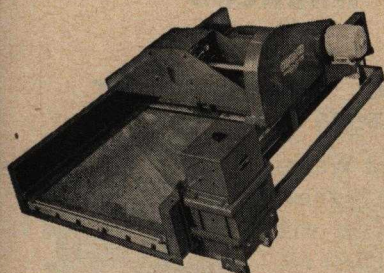
933 Glasgow Avenue, Fort Wayne, Ind.

CONCENCO
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Adelman Machinery Co.....520 First Ave., South, Seattle, Wash.

OVER 50 YEARS EXCLUSIVELY ENGAGED IN THE MANUFACTURE OF SEPARATING AND SIZING EQUIPMENT

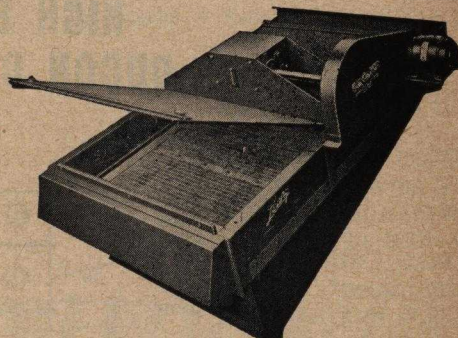


OPEN TYPE MOTOR-DRIVEN
LEAHY SCREEN
WITH FlexElex HEATING

THE
Leahy[®]
**HEAVY
DUTY**

VIBRATING SCREEN

with FlexElex[®] Electric
Jacket Heating Is
The Last Word in



FULLY DUSTPROOF MOTORIZED
LEAHY SCREEN

Fine Screening ...

The new Model E Leahy NO-BLIND[®] Heavy Duty Vibrating Screen is unequalled for screening at fine meshes. Differential Vibration snaps intermediate, wedging size particles loose at the rate of 1600 times per minute, assuring unusual freedom from ordinary blinding problems. For the screening of damp fines, the Leahy screen offers the additional advantage of FlexElex electric heating of screen cloth, described on the opposite page.

Features

An entirely new jacket and mounting concept opens a new range of economic screening applications. Now there is simplified jacket tensioning that insures quickest adjustment for vibratory action, a more uniform tautness and a most effective overall vibration. Extra efficiency is gained in fine clay and shale screening; meshes are kept clear; capacity is increased, uniformity of product is maintained and costs are reduced. Mounting and demounting of screen jackets is easiest and quickest in the field. Power is but ½ H.P., with none wasted to screen frame and supports. Internal vibrating mechanism is doubly dust-proofed. Vibrator runs in oil at slow speed of 265 r.p.m.

Sizes

Built in the following belt or motor drive types: Open type; totally enclosed dust-proof type; single or double surface.

Standard Leahy Screens are built with screening surfaces:

1.5 x 3 ft.	3 x 6 ft.	4 x 5 ft.	4 x 7 ft.	5 x 6 ft.
2 x 4 ft.	3 x 7 ft.	4 x 6 ft.	4 x 8 ft.	5 x 7 ft.
3 x 5 ft.				5 x 8 ft.

Special sizes built to order

Concenco Disc Feeder

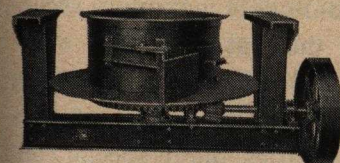
The Concenco Disc Feeder is a simplified machine for metering clay, shale or other ground materials. It is sturdily built and designed to give continuous operation at the lowest cost possible.

The Concenco Disc Feeder will accurately feed at any required rate within necessary commercial capacity ranges. Control of discharge is by the angle of plow, which can be set for any capacity. Adjustments to suit any conditions can be made while the feeder is operating.

This feeder is equipped with a renewable disc of heavy steel plate bolted to a cast iron driving spider.

The Concenco Disc Feeder can be supplied in 60-inch, 48-inch, 42-inch and 36-inch disc sizes; and with sprocket for chain drive instead of flat belt drive where desired.

This feeder can be suspended from the underside of a bin as illustrated or supported on its own base when the brackets are inverted and used as legs.

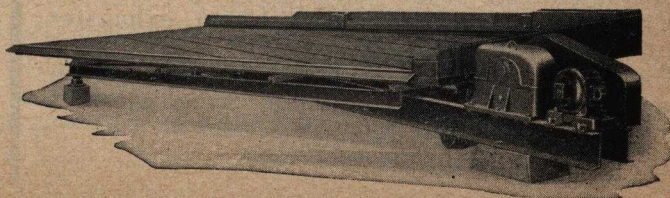


CONCENCO DISC FEEDER

Write for specification sheet covering the six features of this feeder.

SuperDuty Diagonal-Deck Concentrating Table—

This equipment operating on wet specific gravity separating principles produces clean cut products from mixed or contaminated raw materials. It is used in the purification of kaolin, in separating clay from mica, in removing iron or other impurities from glass sand, etc. The SuperDuty table is reasonable in price, easy to install and operate, low in upkeep costs, requires less than 1 H.P. to operate. Write for bulletin.



Patents on Equipment owned or controlled by the Deister Concentrator Company, Inc. Trade Marks Registered in U. S. and Foreign Countries.



THE DUCON COMPANY, INC.

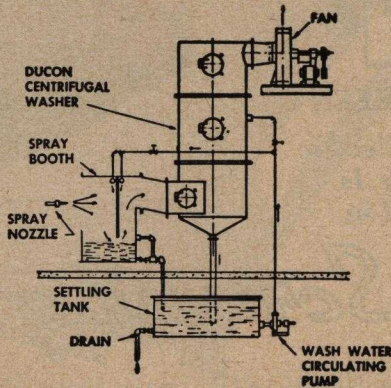
149 EAST SECOND STREET, MINEOLA, N. Y.

In Canada: The Ducon Co. of Canada, Ltd., 1131 Pettit St., Burlington, Ont.

Engineers and Builders of Dust Control Equipment and Glaze Recovery Systems

HIGH EFFICIENCY DUST CONTROL with DUCON CENTRIFUGAL & DYNAMIC WASHERS

Effective control of ceramic dust demands the selection of proper Dust Collecting Equipment. DU-CON engineers, with a broad and long experience in recommending, planning, and installing DUCON Washers and Cyclones in the ceramic industry, offer you expert knowledge and fullest cooperation in determining your specific needs. Whatever your requirement, whether for unit equipment or large systems for efficient removal or recovery of ceramic dust and chips, a careful survey and analysis of your problem will prove DUCON equipment and installations unmatched for high efficiency, durability, trouble-free performance, and long-term economy.

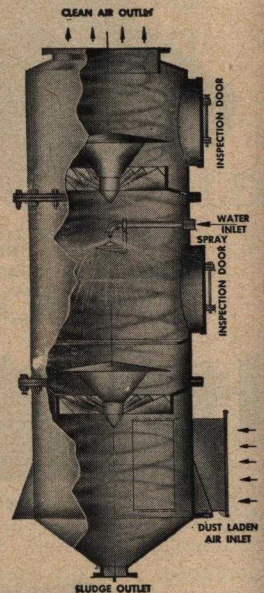


CENTRIFUGAL WASH COLLECTORS

DUCON Centrifugal Washers are designed for highest collection efficiency in wet dust applications. Their advantages include:

- Constant air capacity
- Low pressure drop
- Low water consumption
- Self-cleaning
- Fire and Explosion proof
- Sturdy construction

Performance in excess of 99% usually obtained. Built for easy installation.

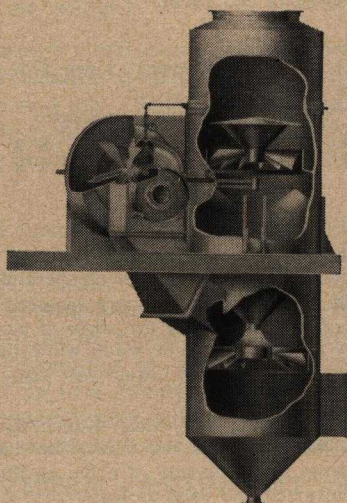


Ask for Bulletin CW-48

DYNAMIC WASH COLLECTORS

The DUCON UW-4 Dynamic Washer is one of the newest and most effective dust collectors for use in the ceramic industry. It is ideal where maximum efficiency is desired at heavy loading. The UW-4 is highly recommended for recovering all types of abrasive dusts and for operations at high temperatures where cloth tube filters fail. It is available as a package unit with fan, exhauster and dewatering tank. The UW-4 Washer has all the inherent advantages listed for the centrifugal type, plus its unique dynamic dust removal action.

Ask for Bulletin W-7456



DUCLONES®

Duclone cyclone dust collectors are designed and manufactured for high efficiency and low resistance to gain maximum recovery of dust at minimum operating expense. Duclones are available in a wide range of sizes and capacities and in special construction and multiple units.

Ask for Bulletin C-958



The Ducon Company also manufactures a complete line of Cloth Tube Filters and Discharge Valves for all types of dust control, pneumatic conveying and feeding applications.

DUCON – The Name in DUST CONTROL

Since 1843



THE EAGLE-PICHER COMPANY

CINCINNATI 1, OHIO

*Regional Sales Offices: Atlanta, Chicago, Cleveland,
Dallas, New York, Philadelphia, Pittsburgh*

West Coast Sales Agent: THE BUNKER HILL COMPANY, Chemical Products Division
Seattle • Portland • Oakland • San Francisco • Los Angeles • Kellogg, Idaho



IS *Shrinkage* **YOUR PROBLEM?**

Then specify

**EAGLE-PICHER
DENZOX**

SHRINKAGE USED TO BE A PUZZLER with matte and semi-matte glazes containing medium to high percentages of ordinary zinc oxide. But then, Eagle-Picher developed Denzox, a unique American Process zinc oxide—and there's nothing ordinary about Denzox!

It's a *lead-free* zinc oxide carefully calcined to insure an extremely coarse and dense nodular product made of large, comparatively uniform sized particles. Result—shrinkage and crawling of glazes on dinnerware, artware, wall tile or structural tile are held to a minimum!

Denzox is a low-bulking material, with an apparent density more than double regular zinc oxide. This means you conserve storage space, too!

Packed in 50-pound multiwall bags, shipments can be made in any quantity from conveniently located plants and warehouses. *Send for a free sample today!*

Other Eagle-Picher products for the ceramic industry

*Lead-free Zinc Oxide • Sublimed Litharge • Lead Silicate
Glass Maker's Litharge • Glass Maker's Red Lead • Potter's
Dry Carbonate of White Lead*

THE EXOLON COMPANY

General Offices: 941 East Niagara Street, Tonawanda, New York
Plants at Tonawanda, N. Y. and Thorold, Ontario

**Manufacturers of Aluminum Oxide and Silicon Carbide for Abrasive and Refractory use.
High Intensity Magnetic Separators and Multi-Deck Vibrating Screens.**

HIGH INTENSITY MAGNETIC SEPARATORS

Specially Designed for Separating Dry, Granular, Weakly Magnetic Materials or those Materials Usually Considered Non-Magnetic

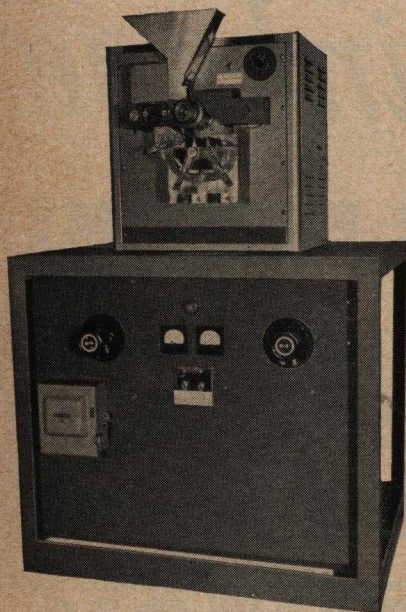
Laboratory Models

For evaluating the feasibility of magnetic separation for quality or yield.

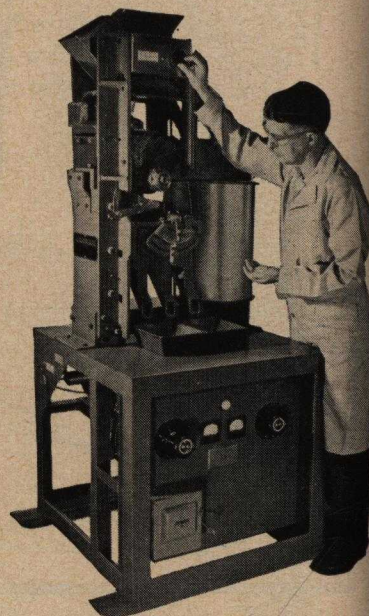
Exolon Magnetic Separators establish a new concept in efficiency and preciseness in separating magnetic materials—particularly weakly magnetic materials.

Material in a grain stream flows onto the highly magnetized revolving rotor. The particles in the stream, which are influenced by magnetism, cling to the rotor longer than the non-magnetic particles. Knife-edge dividers are placed to make the desired separations of the head feed.

Designed by the manufacturers of the Exolon Commercial High Intensity Magnetic Separators, which have been proven in many fields.



Laboratory Model T-20
Magnetic Separator.



Laboratory Model T-25
Magnetic Separator.

Commercial Models

Increases Yields and Quality of Concentrates Produced by other Separating Equipment. Opens New Markets. Produces Better Products at Lower Cost!

Exolon has introduced most of the features now generally accepted as vital to successful high intensity separation. Most important is the position of the pole-nose above the leaving-point of the rotor—a patented principle which insures maximum action of the magnetic flux on the material being separated.

Exolon Separators are economical to operate, requiring less than 1 KWH. per ton of material treated. Control is positive, yet flexible enough to accommodate differences in materials. Construction is to high precision standards, so simple and strong that maintenance is kept to a minimum, and results maintained at uniform high level.

We invite an opportunity to make a test on a sample of your material in our laboratory.

Specifications

THE EXOLON STANDARD DOUBLE 30 MAGNETIC SEPARATOR (See illustration at left)

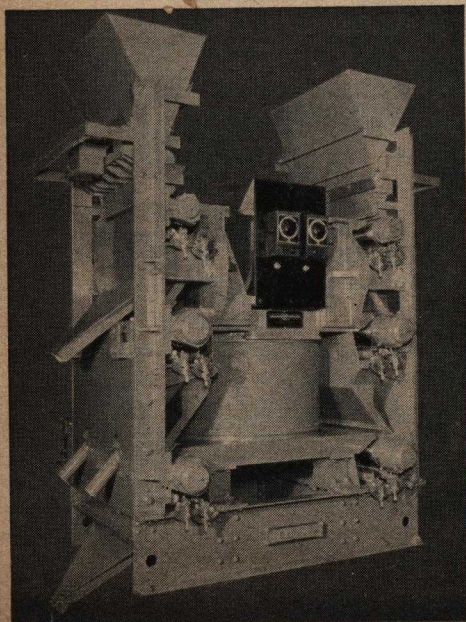
CAPACITY: 2 to 4 or more per hour head feed, depending on material being separated.

POSSIBLE SEPARATIONS: 4, from head feed in one pass through separator.

POWER CONSUMPTION: Approx. 100 watt hours per ton, depending on materials separated.

APPROX. DIMENSIONS: 6' wide x 7' long x 9' high.

WEIGHT: Approx. 14,000 lbs.



The EXOLON Multi-Deck Vibrating Screens

For Faster, More Accurate Sizing, Splitting or Correcting of Ceramic Products

Developed for our own use in the sizing of silicon carbide and aluminum oxide abrasive and refractory grains, the principle on which the Exolon Multi-Form Grader operates is equally adaptable for the handling of many ceramic products.

The Exolon Unit is more than "just a screen." It is a precision tool in the truest sense of the word, producing accurate grades, not merely rough groupings of sizes. It is economical of power and space; screen life is long; upkeep low. Flexible in its adaptability to widely different materials and conditions, it is unyielding in the uniformity of grades produced. Available in several models, and may be completely enclosed if desired for dust-proof operation.

Descriptive bulletin, prices and capacities sent on request.

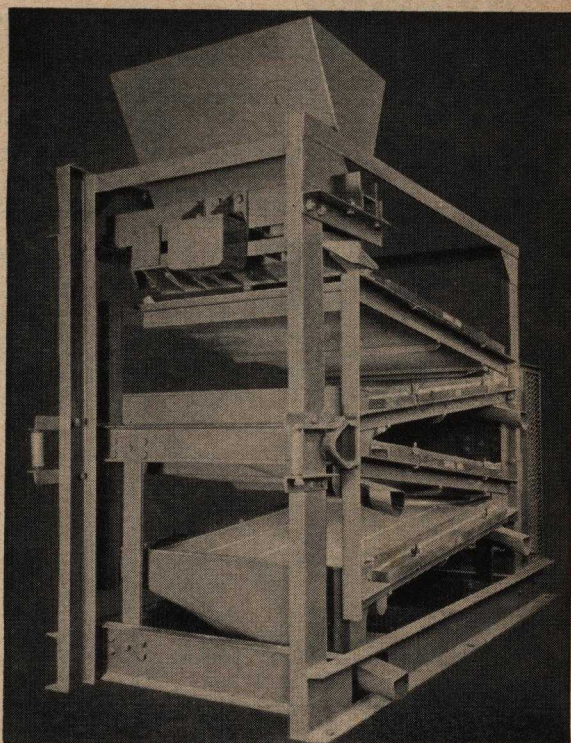
Specifications (Model Illustrated)

Length: 7'-1" Width: 4'-0" Height: 6'-7"

Weight: Approx. 1400 lbs. Size of screen Surface: 34" x 26½"

Standard Equipment includes feed hopper, drive mechanism and motor, and screen frames.

Right: Standard Model Exolon Multi-Deck Vibrating Screen. →



EXOLON Fused Aluminum Oxide and Silicon Carbide

CARBOLON Silicon Carbide Abrasive. For grinding and polishing materials of low tensile strength, such as granite, glass, pearl, jade, leather and rubber, as well as cast iron and non-ferrous metals, CARBOLON has no superior. Its crystals are brittle, each fracture producing additional sharp cutting edges. Furnished in all regular mesh sizes from 8 to 240; also flour sizes.

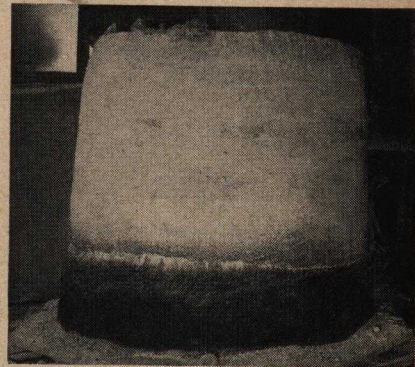
EXOLON Aluminum Oxide Abrasive. An extremely tough, rugged abrasive, EXOLON meets all requirements for grinding and polishing materials of high tensile strength, such as the alloy steels, forgings, etc. It is furnished in all regular grades and flours, in both Regular (94-95% Al_2O_3) and Friable (96-97½% Al_2O_3) varieties.

Exolon Materials For Super-Refractories

Silicon Carbide. Never molten at any stage of its electric furnace production, Exolon Silicon Carbide Refractory Grain has no melting point, dissociating into its component parts at approximately 4060° F. Its resistance to abrasion, low coefficient of expansion and high thermal conductivity (7 times that of fire clay) make it especially valuable in the glass and pottery industries, in zinc smelters, the crucible trade, for kiln furniture, boiler and furnace linings and for special refractories. Its re-

sistance to reducing atmospheres and almost complete inertness to chemical action combine in making a refractory which fills a need supplied by no other material. Available in many run-of-mill and specific mesh gradings.

Aluminum Oxide. Fusing at about 3650° F., Exolon Aluminum Oxide possesses many valuable refractory properties. It resists oxidizing and reducing atmospheres at high temperatures, and is inert to most chemical action. Its thermal conductivity



Aluminum Oxide pig. Water-cooled cylinder removed. Solid pig is ready for preliminary crushing.

is relatively low. It finds its most common use in the production of saggars, special retorts, muffles for enameling furnaces, and for special refractory purposes subjected to loads at high temperatures.

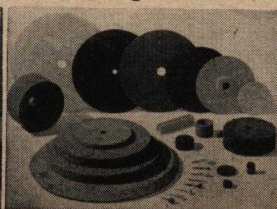
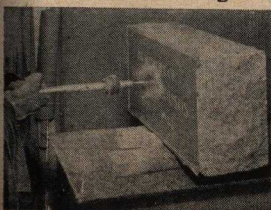
Pressure Blasting

Grinding Wheels

Coated Abrasives

Refractories

Metal Finishing





ELECTRO REFRACTORIES & ABRASIVES CORPORATION

GENERAL OFFICES: 344 Delaware Avenue, Buffalo 2, N. Y.

Plants: BUFFALO, N.Y. and CAP-DE-LA-MADELEINE, QUEBEC, CANADA

Regional Warehouse: LOS ANGELES 58, CALIFORNIA

Mfrs.: ELECTRO-CARB (Silicon Carbide) • REFRACTORIES • CEMENTS • CRUCIBLES • GRINDING WHEELS

ELECTRO SPECIAL REFRACTORIES for the CERAMIC INDUSTRY

MATERIAL	CHARACTERISTICS	APPLICATIONS
KELLOGG AA 85% Silicon Carbide Clay Bond	Highly Resistant To Thermal Stress	Slabs Setters Posts Supports Saggers
KELLOGG 3A Silicon Carbide Silica Bond	Retain High Strength Even At High Temperatures	Girders Muffle Tile
DUPLEX Silicon Carbide Core Facings of Alumina Mullite Zircon	Combine The High Strength Of Silicon Carbide With Inertness Of The Oxide Facing	Slabs Setters
DIMUL F Bonded Fused Mullite	Refractoriness Permits use to 3200°F Non Reactive	Slabs Setters Saggers
DIMUL Bonded Converted Cyanite	Resistant To Thermal Stress Inert	Posts Setters Saggers

**ENGLISH CHINA CLAYS
SALES CORPORATION**

6 East 45th St., NEW YORK 17, N. Y.

Superior Pottery Clays

ENGLISH CHINA CLAYS - - - - NO. 1. 10. 247 and 30.

ENGLISH BALL CLAYS - - - - - NO. 1 and 25.

GROUND CORNWALL STONE

Every characteristic essential to High Quality — Uniformity and Reliability is found in our English China and Ball Clays. . . . That is why these clays are in universal use by ware manufacturers who demand the best. . . . It is good, sound policy to standardize on these clays of widely known and recognized merit.



Pacific Coast Representative . . **BALFOUR, GUTHRIE & COMPANY, LTD.**
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THE FATE-ROOT-HEATH COMPANY

Dept. B-7

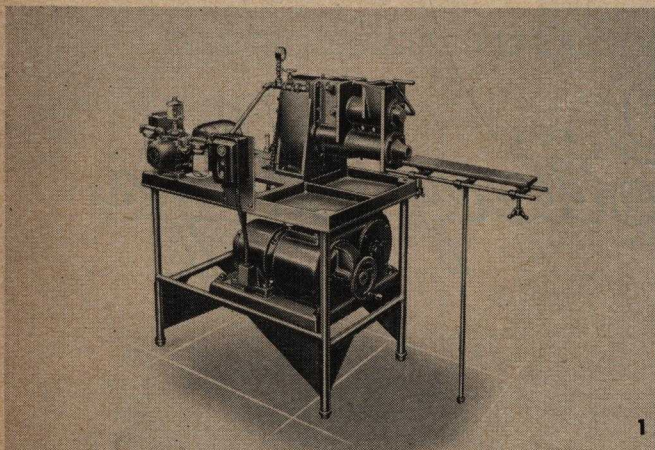
Plymouth, Ohio

De-Airing Brick Machines
De-Airing Building Tile Machines
De-Airing Drain Tile Machines
De-Airing Sewer Pipe Extrusion Machines

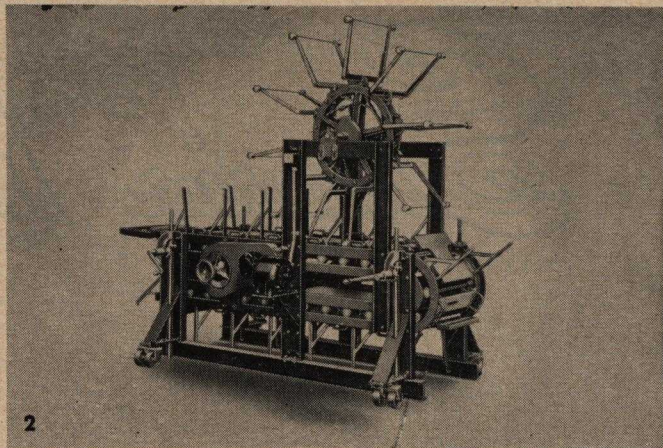
De-Airing Pug Mills
Crushers
Disintegrators
Side Cut Brick Cutters

End Cut Brick Cutters
Building Tile Cutters
Drain Tile Cutters
Floor Tile Cutters

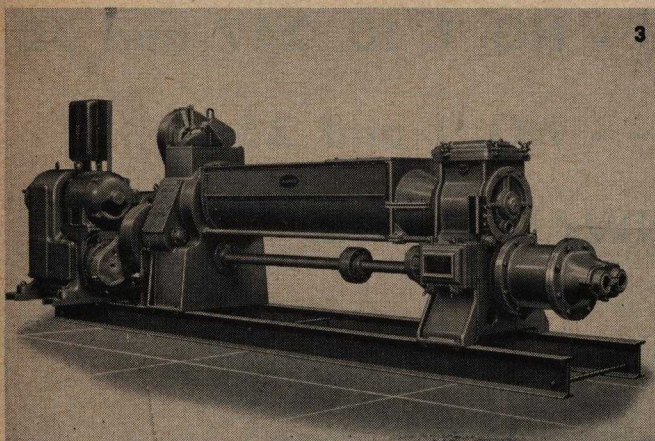
Delivery Belts



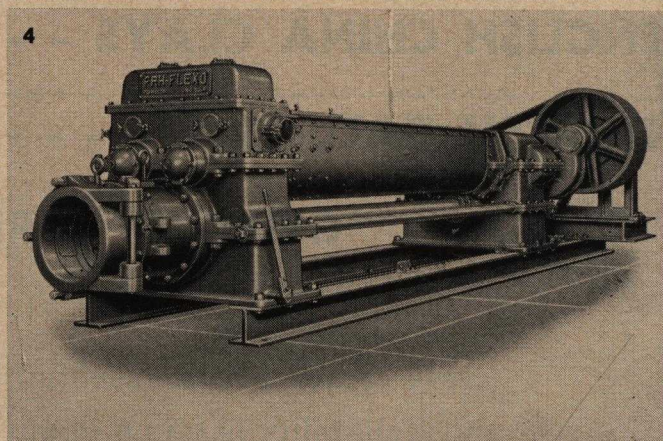
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3



4

LABORATORY PUG MILL

1. This auger type ceramic vacuum pug mill is designed for Laboratories, Ceramic Colleges, and the limited production of ceramic specialties such as spark plugs, resistor cores, solid rounds, ribbons, rectangles, and squares. Capacity measures up to 100 pounds per hour depending upon material, moisture content, auger speed, and die size. Dies up to 2½" bore diameter may be used with this machine.

AUTOMATIC CUTTERS

2. There is an F-R-H automatic cutter for use with virtually every clay auger machine. Although the mechanical principle involved in these cutters has distinguished the F-R-H line for nearly 40 years, the cutters themselves are modern in every detail. Hyatt Roller Bearings in the linkage of the carrier chains assure long wear, easy operation, and a sensitive, accurate cut. F-R-H cutters are available for building tile, drain tile, and for brick.

PUG MILLS

3. F-R-H de-airing pottery pug mills are the finest and most efficient obtainable. Eight horizontal, three vertical sizes, all built to stand up under years of service, offer a capacity range of 3 to 10 tons per hour. Model C shown here has a

capacity of 5 to 6 tons per hour and can extrude solid rolls that range from 1½" to 16" as well as shapes that vary all the way from small ribbons to intricate patterns, tubes, etc. A wide variety of special attachments are available.

BRICK & TILE MACHINES

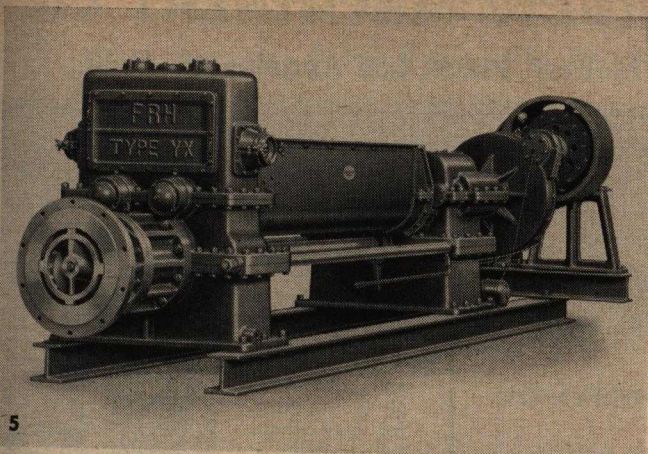
4. F-R-H de-airing machines for brick and tile are made in four sizes with capacities for turning out 50 to 80 tons of solid green ware per hour, or 7 to 35 tons of hollow green ware per hour. Constructed with machine-tool-precision, these modern machines feature anti-friction bearings, hardened cut-steel gears, and heavy, high-carbon shafting. Joints are wide, fully machined, and permanently sealed to assure high vacuum and highest quality extrusions.

Write for complete information to The Fate-Root-Heath Company, Dept. B-7, Plymouth, O.

F-R-H

CERAMIC MACHINERY

Also manufacturers of Plymouth Locomotives



5

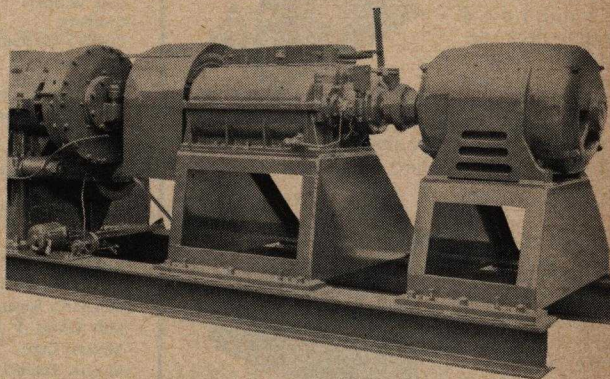
6. 4-SPEED TRANSMISSION FOR F-R-H DE-AIRING BRICK & TILE MACHINES

Available on several models, transmission permits proper gear selection for all clay conditions, maximum output at all times. Especially desirable for sewer pipe extrusion where various diameters of pipe require varying drive speeds.

5. COMBINATION DE-AIRING—

EXTRUSION BRICK & TILE MACHINES

The Type YX Combination De-Airing—Extrusion Brick and Tile Machine is geared to permit the use of high speed motors, more efficient and less costly drives. It incorporates "new ideas" for the efficient extrusion of drain tile and sewer pipe—which offer substantial savings in both operating and maintenance costs. Machine has V-belt drive direct-connected to motor or 4-speed transmission. It offers air clutch or mechanical drive.

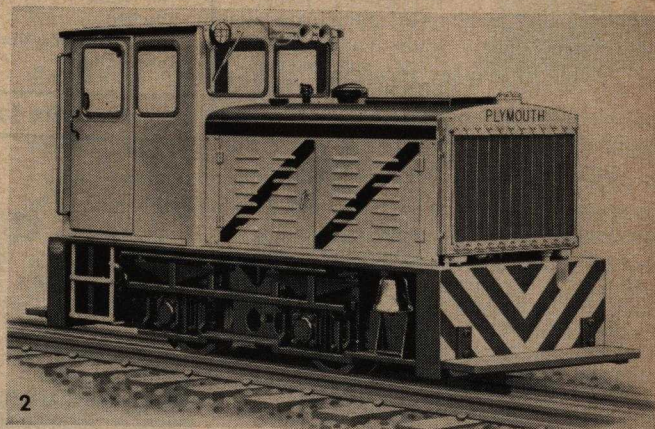


PLYMOUTH LOCOMOTIVE WORKS

Division of THE FATE-ROOT-HEATH COMPANY • Dept. A-18 • Plymouth, Ohio

- 3 to 80-ton Sizes Available
- Standard or Narrow Gauge Models
- Gasoline or Diesel Models
- Torqomotive or Mechanical Drive

Heavy loads? Steep grades? Sharp curves? . . . Plymouth Locomotive take them all in stride. Each is built to give excellent low-cost operation year after year. The manager of a brick and tile company in Virginia states: "What our operator likes best about our Plymouth is its stability on the track and its ease of operation. After fifteen years of hauling clay over grades up to 5% we couldn't ask for anything better."



2

2. 8 and 10 Ton Plymouths—Gasoline or Diesel

Ruggedly built 8 and 10 ton Plymouths are available with welded steel or cast iron frames. Wheel bases of 45 3/16" and 55 1/4". Radius of sharpest curve 23'; Gauges available 23 5/8" to 56 1/2". Mechanical or Torqomotive Drive.

For complete information on Plymouth locomotives, write to:

PLYMOUTH[®] TORQOMOTIVES

Builders of F. R. H.
Ceramic Machinery



SINCE 1886

FERNHOLTZ MACHINERY CO.

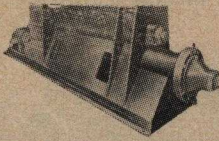
8468-D Melrose Place, Los Angeles 46, Calif.

IT'S STANDARD PROCEDURE on the West Coast to CALL FERNHOLTZ First—for CERAMIC, BRICK or CLAY MACHINERY

BRICK & CLAY PRODUCTS

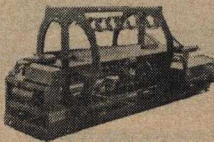
AUGER MACHINE

INTERNATIONAL—Combined double-deck de-airing Auger Machine and Pug Mill, all-new features including all bearings accessible from outside machine—extruding brick, tile, sewer pipe.



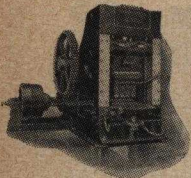
HYDRAULIC CUTTERS

FERNHOLTZ Automatic Hydraulic Cutter for brick, building tile, drain tile, quarry tile and roof tile.



DRY PRESSES

INTERNATIONAL Special Heavy Duty Dry Presses for brick, tile, refractory brick, insulating brick, and paving block, de-airing available.

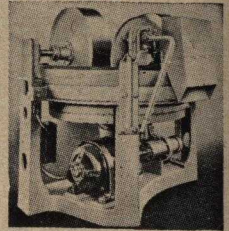


Agitators
Auger Machines
Balls, Porcelain Grinding
Balls, Grinding, High Density Alumina
Blungers
Cars, Kiln
Clay Washers
Crushers
Cutter, Hydraulic Brick and Tile
Dry Presses
Dryers, Rotary
Fans, Kiln, Stack
Filter Press Pumps
Filter Presses
Flower Pot Machines
Jiggers, Pulldowns
Jiggers, Oval
Hammer Mills
Kilns, Electric, Gas
Kiln Cars
Kilns, Rotary
Laboratory Equipment
Magnetic Separators
Mill Lining & Balls
Mixers, Clay
Mixers, Enamel
Mixers, Slip & Glaze
Pans, Wet or Dry
Pebble & Ball Mills
Po. table Mixers
Pug Mills
Pumps, Slip & Glaze
Sewer Pipe Press, Hydraulic
Slip Screens
Tile Presses
Tile Dies
Tile Spraying Machines
Tunnel Kilns

TILE MACHINERY

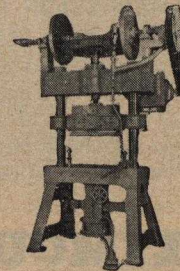
MIXERS, PANS

CLEARFIELD muller mixers with dust hood, batch loaders and manual or air unloading, for clay, shale, talc bodies or similar materials.



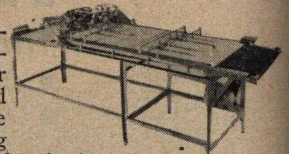
TILE PRESSES

WIELAND Friction Power Tile Presses for high grade tile production. Also hand operated.



FETTLING TABLE

Automatic Fetting Table Motor Driven for cleaning and brushing of the tile after leaving tile press. Built for single, 2 abreast, 3 abreast and 4 abreast pressing. These Wieland Fetting tables are built to handle both lug-type and plain-type tile.

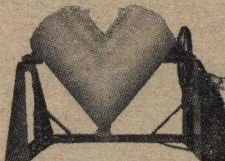


• Write for Descriptive Catalogs on any of this Equipment.

POTTERY & ENAMELING

TWIN SHELL BLENDER

PATTERSON-KELLEY—unsurpassed for high speed precision blending, Intensifier bar for material difficult to blend, Liquid-Feed Intensifier for introduction of liquid to tile body and brick bodies, shell construction: steel, stainless steel, transparent plastic shell, dust-tight water-tight shells, capacity 4-pt. to 1300 cu. ft.



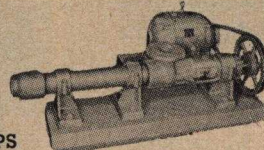
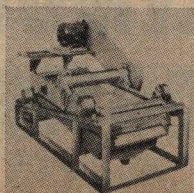
GRINDING JARS AND MILLS

FERNHOLTZ Model No. 69 Jar Mill single place with rubber covered rollers and motor drive; Model 79 four place mill with motor. Grinding jars in all sizes from 1 qt. to 6 gal.



VIBRATING SCREENS

OVERSTROM Vibrating Screens for screening slip, glaze, enamel (wet, dry), pigments, oxides, clay and similar liquid materials.



MOYNO PUMPS

ROBBINS & MYERS—"The Progressive Cavity Pump" for transfer and filter press service for clay slip, glaze, and enamel.

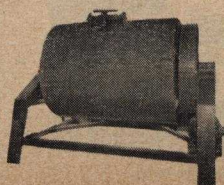


TUNNEL & SHUTTLE KILNS

Kilns at sensible prices for brick, tile, sanitaryware, whiteware and art ware production. Custom engineered and built right on your job site to suit or shipped factory erected to your job site.

FERNHOLTZ BALL MILLS

Gearhead motor drive, conical bridge-type construction, self-aligning roller bearings, lined with McDanel porcelain, high density alumina, silex, rubber or steel.



GYRATORY SCREENS

COMBS Gyratory Screen Motor driven for screening slip, glaze, and enamel wet and dry.



DE-AIRING AUGER MACHINES

INTERNATIONAL Vac-Aire de-airing Combined Auger Machine Pug Mill for plastic clays, filter press cake and related materials requiring mixing, de-airing, and extruding.



PORTABLE MIXERS

Complete range of sizes laboratory mixers to large tank agitators for mixing clay, glaze, enamel, paint, etc.



FERRO CORPORATION

4150 East 56th Street • Cleveland 5, Ohio



World's only complete porcelain enameling service

... including Plant Layout ... Furnace Design and Construction ...
Product Design Assistance ... Enamel Selection ... Color Matching Service
... Plant Start-Up Supervision ... Production Trouble-Shooting ... Cost
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Brakpan, Transvaal, South Africa

PORCELAIN ENAMEL FRITS

As a foremost producer of Porcelain enamel frits, Ferro manufactures a comprehensive line to meet every type of application on steel or aluminum, including smelted-in colors. A fully equipped research and development laboratory, staffed with nationally known technical experts, is available to advise you on new and special frits to meet your special requirements.

FERRO FLAKE FRIT

Write for full information on this revolutionary new frit which can offer you these advantages:

- | | |
|--------------------------------------|---------------------------------------|
| 1. More uniform grinding. | 4. No dust in mill loading. |
| 2. Improved color stability | 5. More uniform set characteristics. |
| 3. Greater resistance to hairlining. | 6. No precipitation of soluble salts. |

PLANTS, FURNACES, EQUIPMENT

Ferro services include complete plant layouts, furnace design and installation, planning of pickling, spraying and drying processes, and movement of ware through the entire system. Furnace construction includes all types ... box or intermittent, V-type continuous, straight continuous ... each designed for the most efficient use of fuel, whether oil, gas, coal, electricity, or a combination.

ENGINEERING SERVICES

Qualified Ferro engineers and research technicians are constantly available to come into your plant with help on any enameling problem. Periodic plant and furnace checkups are

part of this service which includes the most scientific and technological advancements in the enameling industry.

CLAYS, COLORS, SUPPLIES

Ferro's clays are selectively mined to meet exacting production requirements. All Ferro clays are processed under strict quality-control conditions, and with a quarter of a century of background and experience in clay processing to draw on.

A complete line of color oxides is included in Ferro's supplies to the industry. A modern color laboratory, fully staffed, offers you the best in colors, produced under the strictest quality control. Color matches and special color recommendations are part of the service.

Our many years' experience in all phases of ceramic production qualify us to offer you the most efficient and economical supplies to meet your particular requirements.

A partial list of supplies available:

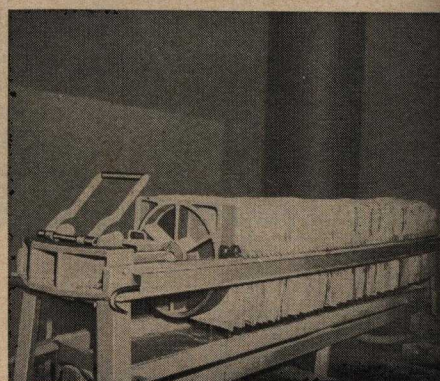
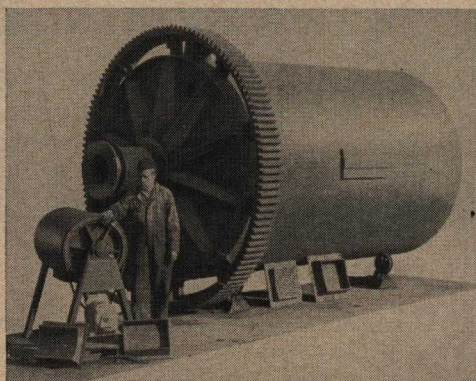
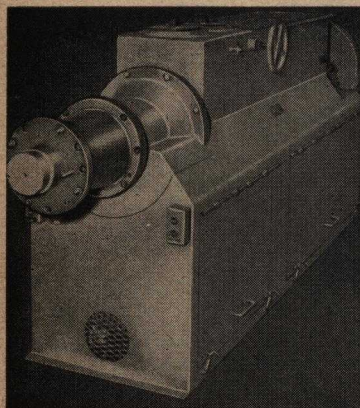
Antiscale compounds	Control equipment	Pickling Machines
Aprons	Dip tanks	Pumps
Asbestos supplies	Dipping Machines	Pyrometers
Brushes	Dryers	Refractories
Beading sponges	High density mill	Respirators
Buhrstone	lining blocks	Rotosprays
mill linings	and balls	Rubbing stones
Burning bars	Mills	Sieves
and racks	Muffles	Spray booths
Charging forks,	Pebbles	Spray Machines
unloaders	Pickle baskets	Thickness gauges
		Timer clocks

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C. O. FIEDLER, INC.

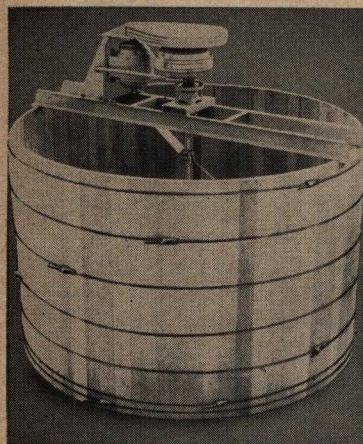
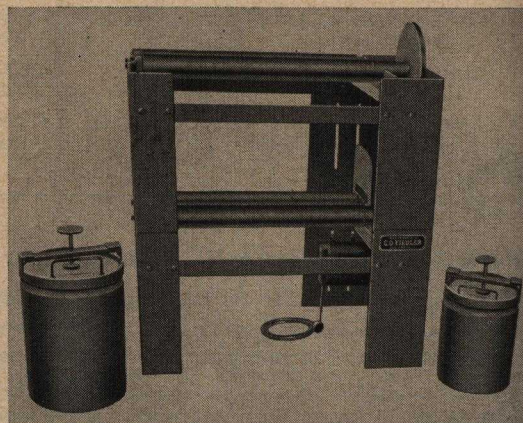
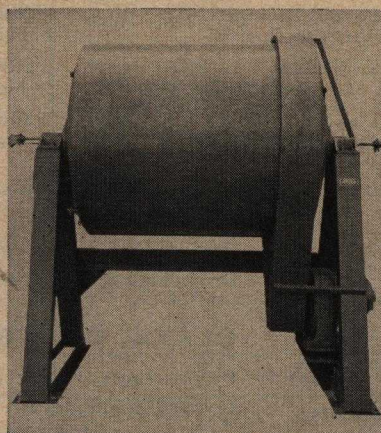
P. O. BOX 58433, VERNON BRANCH, LOS ANGELES 58, CALIFORNIA

The Fiedler De-Airing Pug Mill is designed to fit your needs and delivers a finished body of superior quality. In use in plants producing fine china, pottery, insulators and in schools and laboratories throughout the country. Capacities to ten tons per hour with 29" vacuum.



The simple but extremely efficient design and quality of workmanship in Fiedler Pebble Mills has earned for us a reputation of which we are justly proud.

Filter presses, 18" plate, or 24" plate capacities from 100# to 2000# per run. We stock replacement sacks for filter press plates.

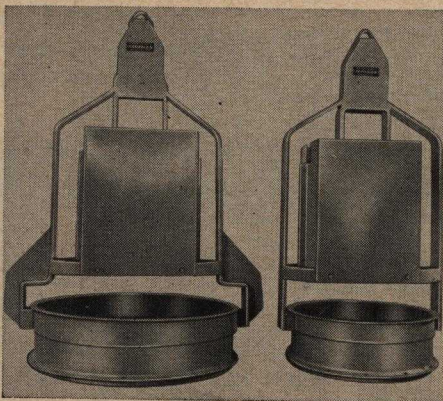


Agitators, Blungers, Mixers and Blenders.

Our slip screens are designed to meet the most exacting requirements and can be quickly changed from one mesh size to another. Our exclusive method of screen mounting gives you more gallons of slip for your dollar.

Jar Mills.

For the laboratory, for the hobbyist, or for production where the quantities are not too large. 3" diameter rollers, with $\frac{3}{8}$ " pure gum or synthetic rubber cover to insure long life. Ball bearing mounted for the most satisfactory operation. The space between the rollers is adjustable for operation with jars ranging in size from one quart to six gallons. We will fabricate multiple deck or special sized Mills to suit your particular requirements.



Rubber	6 Gal.	All	5 Gal.
Lined	3 Gal.	Steel	3 Gal.
Steel	1 Gal.	Jars	2 Gal.
Jars	$\frac{1}{2}$ Gal.		5 Qt.
			2 Qt.
Porcelain	5 Gal.		
Lined	3 Gal.		
Steel	2 Gal.		
Jars	5 Qt.		
	3 Qt.		

PHONE LUdlow 3-2297

P. O. BOX 58433, VERNON BRANCH
LOS ANGELES 58, CALIFORNIA

MANUFACTURED BY
C.O. FIEDLER
LOS ANGELES

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- LITHIUM FLUORIDE
- LITHIUM CARBONATE
- LITHIUM CHLORIDE
- LITHIUM CITRATE
- LITHIUM NITRATE
- PETALITE, AMBLYGONITE, LEPIDOLITE (lithium ores)
- CHROMITE
- EBONY MANGANESE
- MAGNETITE (black iron oxide)
- FELDSPAR (potash)
- RUTILE (titanium ore)
- STRONTIUM CARBONATE
- ZIRCON (milled or concentrates)
- PYRITES
- MANGANESE SULPHIDE



FOOTE MINERAL COMPANY

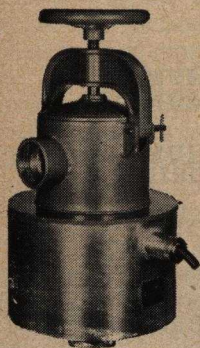
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P. O. Box 1138

Trenton 6, New Jersey

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PIPELINE FERROFILTER

Completely enclosed. Cover secured by yoke and handwheel which permit easy opening for removal of grid stack and cleaning. Usually installed in vertical position for upward flow. Five sizes with capacities from 50 to 2000 U.S. gallons per hour and pipe connections from 1" to 3".



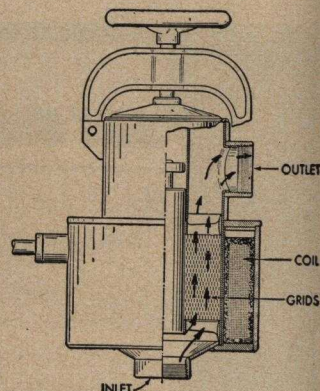
MAGNETIC SEPARATORS

The Frantz Electromagnetic FERROFILTER is standard equipment in almost all ceramic plants. It is made in different types for eliminating iron contamination, both from liquids and slurries and from powdered and granular materials.

The FERROFILTER consists essentially of a stack of grids, strongly magnetized by a direct current coil enclosed in a steel shell. This provides extremely high efficiency of removal of iron particles which cling to the edges of the grids as long as the current is on and the grids magnetized. Grids are furnished with the proper size openings for the consistency and flow characteristics of the material.



For more complete information on the full line of FERROFILTERS send for Bulletin 58-E.



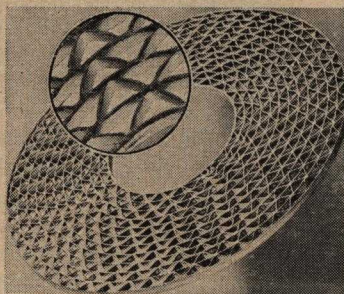
How the PIPELINE FERROFILTER Operates

The liquid enters through bottom pipe connection, passes through magnetized grids and discharges at the top. Easily cleaned by switching off current—then back washing or removing grid stack.



GRAVITY FERROFILTER

Material flows into open bowl and is discharged through bottom central opening. Float valve regulates flow. Automatic shut-off, except on smallest size, if power fails. Four sizes—all easily portable; 50 to 2000 U.S. gallons per hour.



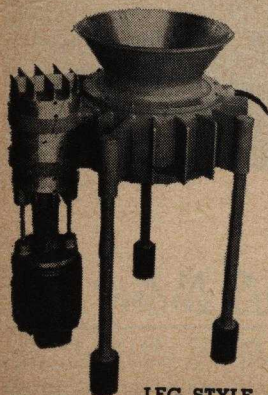
WET FERROFILTER GRID

One of stack of 16 to 30 grids, the heart of wet FERROFILTERS. Magnified inset shows iron particles clinging to edges of grid. GRIDS are easily removed for cleaning, or can be left in unit and flushed clean when power is off.

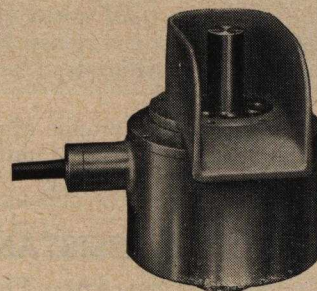
DRY FERROFILTERS

For the removal of large and small magnetic particles from powdered and granular materials in tonnage lots, the Frantz Dry FERROFILTER has proved most effective in hundreds of plants.

Material is fed in at the top and is discharged directly from the bottom. The capacity of these units depends upon the specific gravity, fineness, moisture content etc. of the material. An eccentric-weight, adjustable vibrator, securely attached to the separator, provides the right amount of shake for each material handled. It is completely enclosed and driven through a flexible shaft so that the motor is not subject to vibration. The FERROFILTER casing is surrounded by cooling fins. Model 68-V is available in leg and suspended styles with capacity from 25 to 200 cu. ft. per hour; Model 88-V in suspended style with capacity from 125 to 1000 cubic feet per hour.



LEG STYLE



UNDERFEED FERROFILTER

Liquid enters at bottom and discharges through open spout at top. Great accessibility of all parts for ease of cleaning. Three sizes with capacities from 130 to 2000 U.S. gallons per hour and pipe connections from 1½" to 3".



SUSPENDED MODELS

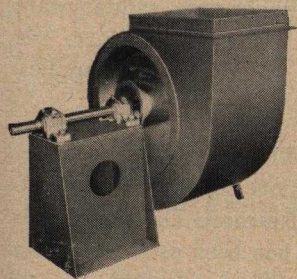
GARDEN CITY FAN COMPANY

801 North 8th Street

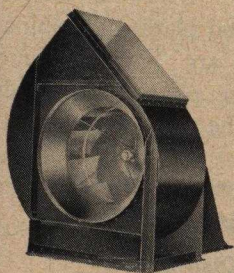
Niles, Michigan

Representatives in principal industrial cities.

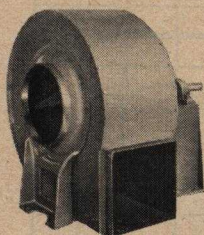
Manufacturers of Design "B" Multiblade—Non-Overloading—Hi-Static and HSH Cycloidal—RF (Radial Blade) and C. I. Small Exhaust Fans. Wheels designed in forward curved, backward curved and radial blade types for various commercial and industrial applications. Suitable for high temperature air circulation to 1850°F., air conditioning and ventilating, dust and fume removal, materials conveying and special applications requiring "Custom-built" features. High temperature fans to 1700°F. are equipped with a special "Air-Cooled" Shaft which eliminates bearing failures caused by excessive temperatures. Water-cooled shaft is used for temperatures above 1700°F.



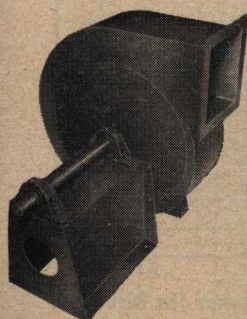
Design "B" Multiblade Fans



Non-Overloading Fans



Hi-Static and HSH Cycloidal Fans



RF (Radial Blade) Fans



C. I. Small Exhaust Fans

Design "B" Multiblade Fans—Compact, low speed air and gas handling fans with forward curved blades. Ideally suited for systems with space limitations or low noise level requirements. Made for temperatures to 1650°F. with uninsulated housing, with insulated double housing or as insulated Plug Unit. Plug Units are available without housing, with conventional fan housing or with diffuser vane assembly.

Non-Overloading Fans—High speed air and gas handling fans with backward curved blades. Non-overloading power characteristics. Made for temperatures to 725°F. Ideally suited for systems with fluctuating system resistance.

Hi-Static and HSH Cycloidal Fans—Rugged material handling and conveying fans. Two classes of construction designed to handle a wide range of materials. Specially designed "non-clogging" Cycloidal wheel reduces power requirements while offering efficient performance at low speeds.

RF (Radial Blade) Fans—Heavy duty air, gas and material handling fans for industrial service. Used for all high temperature applications, for light material handling applications and for exhausting against high pressures. Made for temperatures to 1850°F. with uninsulated housing, insulated double housing or as insulated Plug Unit. Plug Units are available without housing, with conventional fan housing or with diffuser vane assembly.

C. I. Small Exhaust Fans—Durable air, gas, and material handling fans with heavy cast housing. Made for temperatures to 1650°F. Particularly suitable for applications requiring small volumes at moderate static pressures.

Further information and literature available upon request.

GCF Fans and
Blowers for
Ceramic and Clay
Products Operations

Air Conditioning

Blowing

Calcinating

Circulating

Cooling

Conveying

Drying

Dust Collecting

Exhausting

Firing

Furnaces

Heating

Kilns

Melting

Preheating

Pressurized Spray Booths

Your requirements given careful attention. When you require fans and blowers, write or phone giving CFM, SP, and application data. Our engineering service department will be pleased to quote fan equipment best suited for most economical investment.



GEORGIA KAOLIN COMPANY

1189 Mary Street, Elizabeth 3, New Jersey

Producer of fine clay for the ceramic industry since 1901

Mines and Plants at DRY BRANCH, GEORGIA

QUALITY CHINA CLAYS

(Water Washed and Air Floated)



You can rely upon GEORGIA KAOLIN CLAYS with complete confidence for your precision controlled ceramic products. Our PIONEER and VELVACAST clays have been the leading domestic china clays of the ceramic industry for many years, because of their outstanding quality, performance and economy.

PIONEER CLAY is a plastic kaolin, noted for its whiteness, strength and excellent forming qualities.

VELVACAST CLAY is an open-grained kaolin which excels as a casting clay, gives controlled drying rates,

and minimizes warpage. Its particle size is scientifically controlled by centrifugal fractionation to assure uniform working properties.

PIONEER and VELVACAST clays are used extensively in the manufacture of dinnerware, sanitaryware, special refractories, electrical porcelain, artware, tile, enamels, glazes, saggars, and special ceramic applications.

The PARTICLE SIZE ANALYSIS of Pioneer and Velvacast may be interpreted more correctly in the light of recent discoveries of the Research Division of the Georgia Kaolin Company. It has been established that kaolinite particles change shape at about 2 microns (equivalent spherical diameter). Below 2 microns, single, thin, flat, hexagonal, crystal plates predominate. Above 2 microns, the particles are "stacked" inter-crystallized aggregations of these plates. These phenomena are clearly indicated in the graph below.

TYPICAL CHEMICAL ANALYSES PIONEER AND VELVACAST CLAYS

	PIONEER	VELVACAST
Silicon Dioxide	45.34	45.12
Aluminum Oxide	37.29	38.12
Iron Oxide	0.61	0.63
Titanium Dioxide	1.54	1.35
Calcium Oxide	0.25	0.03
Magnesium Oxide	0.22	0.22
Sodium Oxide	0.35	0.31
Potassium Oxide	0.10	0.13
Free Moisture	1.01	0.30
Combined Water	13.38	13.75

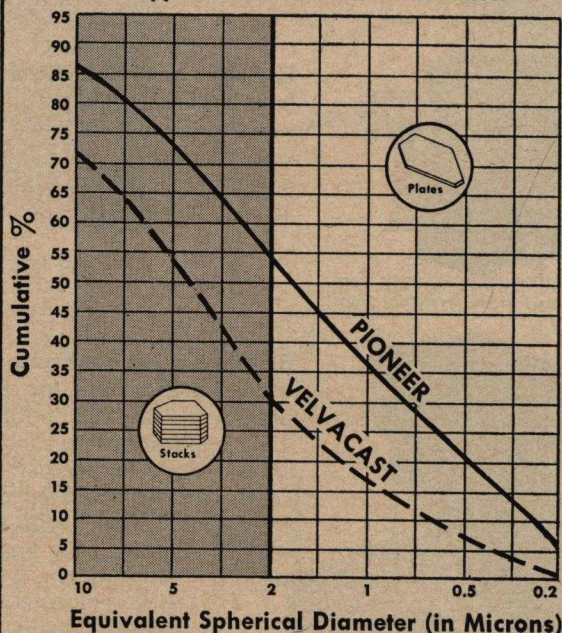
TYPICAL PHYSICAL PROPERTIES CLAY ALONE

	PIONEER	VELVACAST
DRY PROPERTIES		
Shrinkage: % (wet basis)	5.74	5.10
Modulus of Rupture: p.s.i.	360	56
Water of Plasticity: %	29.2	31.6
FIRED PROPERTIES: Cone 10		
Shrinkage: %	10	8.3
Absorption: % (5 hrs. boiling)	8.4	16.7
Color:	White	White

50% CLAY—50% FLINT

DRY PROPERTIES		
Shrinkage: % (wet basis)	5.40	3.77
Modulus of Rupture: p.s.i.	339	44
Water of Plasticity: %	25	26.7
FIRED PROPERTIES: Cone 10		
Shrinkage: %	2.44	2.25
Modulus of Rupture: p.s.i.	3342	
Absorption: % (5 hrs. boiling)	16.8	22.9
Color:	White	White

PIONEER — VELVACAST -- Typical Particle Size Distribution



GENERAL PROPERTIES OF PIONEER AND VELVACAST CLAYS

Pyrometric Cone Equivalent: 33-34. Maximum Screen Residue—200 mesh: less than 0.20%. Aqueous Viscosity of Velvacast: 71% Solids, fully dispersed. Brookfield Viscometer 10 R.P.M. — Maximum—750 cp.

Send for samples and further information.

GEORGIA KAOLIN COMPANY

1189 Mary Street, Elizabeth 3, N. J.

Producer of fine clay for the ceramic industry since 1901



GK AJAX KAOLINS

New Controlled Clays to Achieve:

★ Whiter Color
★ Higher Strength

★ Cleaner Surfaces
★ Faster Firing Cycles

★ Smoother Surfaces
★ Dimensional Control

Ajax P Kaolin may be considered as a refined ball clay because it is water-washed and fractionated to a fineness below 2 microns. This refining produces a clay totally free of specking minerals. Ajax P Kaolin is low in Fe_2O_3 content and, therefore, fires to a white color, whiter than most ball clays. All unit-forming operations become more uniform with Ajax P Kaolin because of its controlled strength and plasticity.

Ajax SC calcined kaolin facilitates rapid, homogeneous batching and vitrification as a result of its controlled particle size distribution. Smooth surfaces are assured in casting, pressing, and extruding because of its relative fineness. Close dimensional tolerances can be maintained by virtue of prior elimination of the natural shrinkage and expansion of the kaolin during calcination. The thermal stability and freedom from mineral inversion permit faster firing cycles with Ajax SC as the major body component.

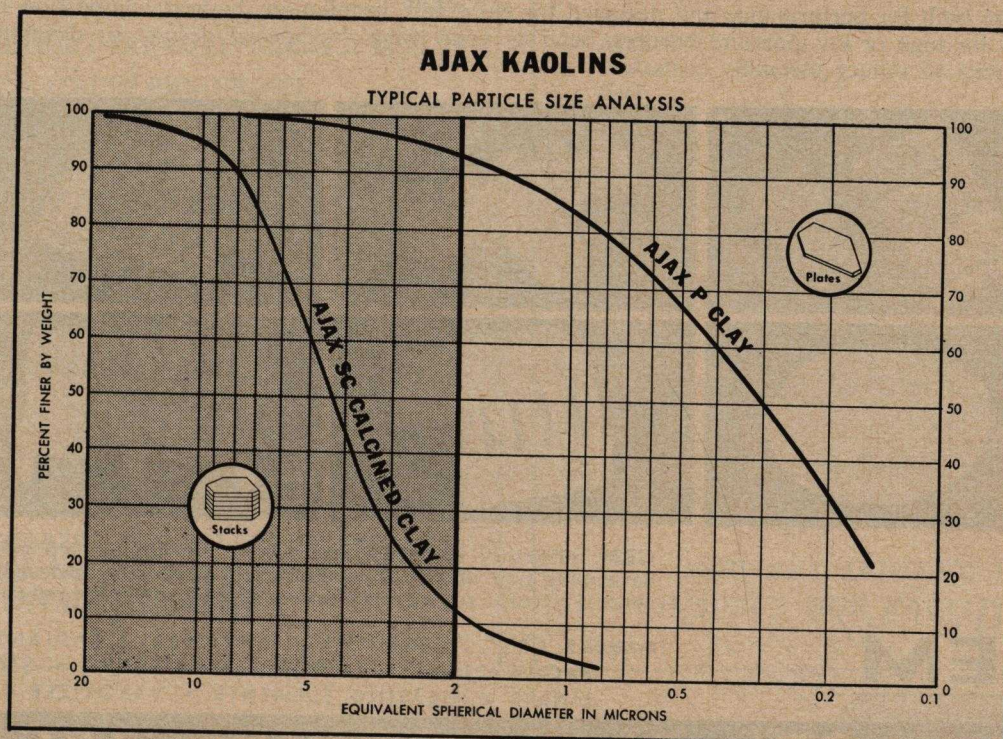
Ajax Kaolins can be used alone or in combination to improve your product. They are new materials for use in automated operations.

Ajax kaolins are recommended for: floor and wall tile, special refractories, electronic ceramics, glazes, sanitary ware, enamels, alumina ceramics, spark plugs, electrical porcelain, saggars, artware, coatings, castings, and various other applications.

Our technical service department is exceptionally well-equipped to provide technical data and service.

TYPICAL CHEMICAL ANALYSES

	Ajax P Clay	Ajax SC Calcined Clay
Silicon dioxide	45.20%	53.08%
Aluminum oxide	38.02	44.40
Iron oxide	0.494	0.40
Titanium dioxide	1.95	0.95
Calcium oxide	0.26	
Magnesium oxide	0.30	
Sodium oxide	0.02	0.31
Potassium oxide	0.04	0.39
Loss on ignition	13.51	

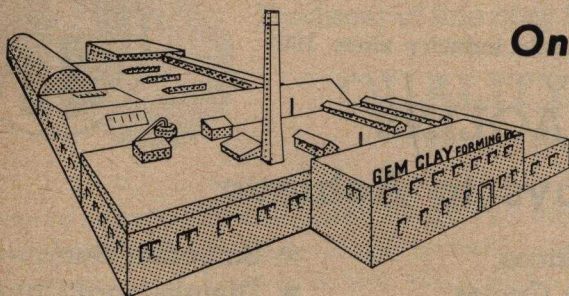


Send for samples and further information.

GEM CLAY FORMING, INC.

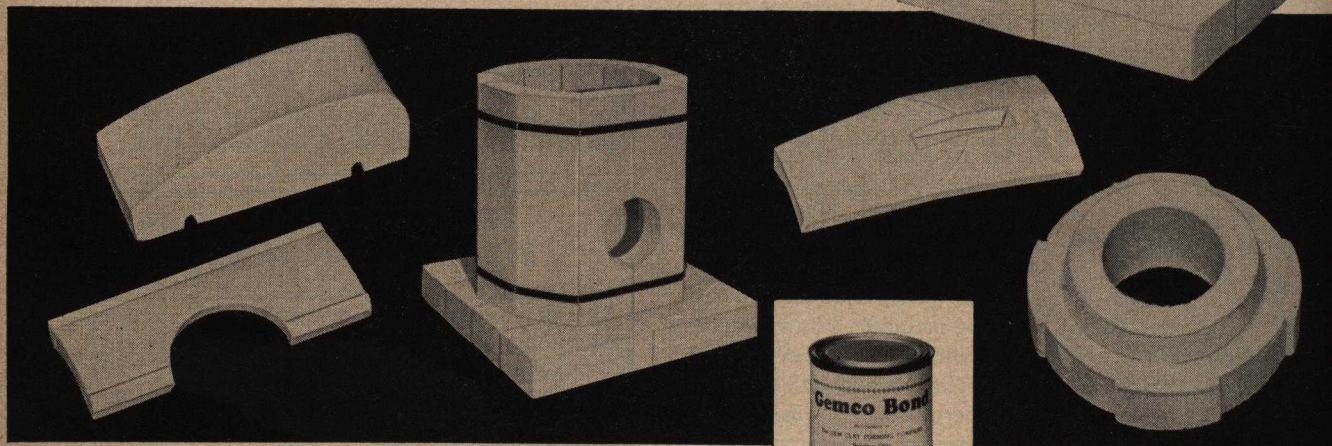
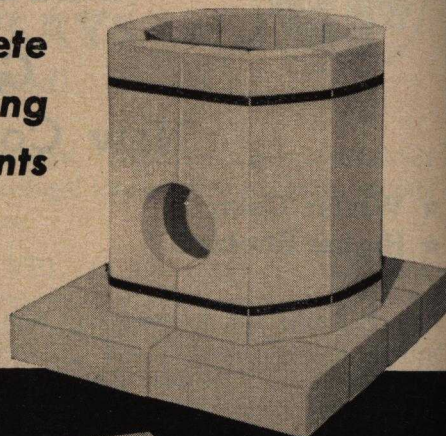
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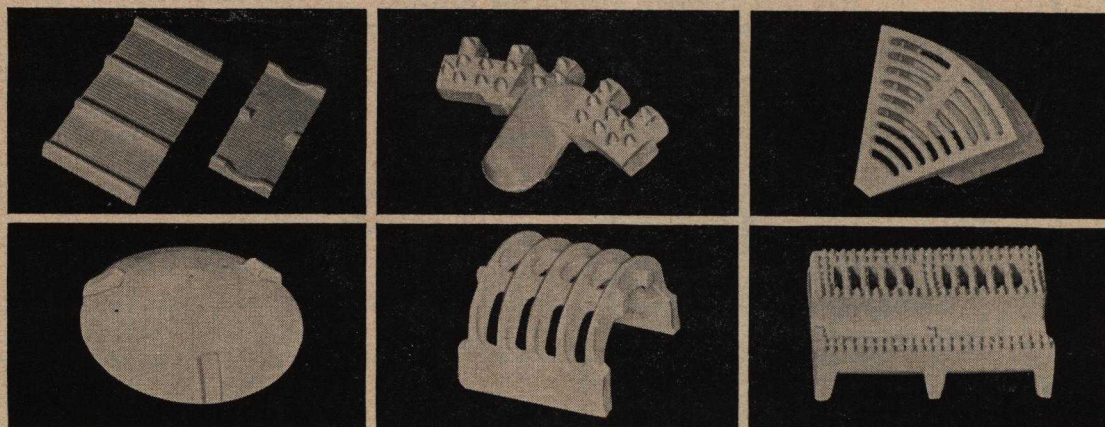


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... Refractory Cement
insures maximum bonding strength.

GEM COMBUSTION CHAMBERS

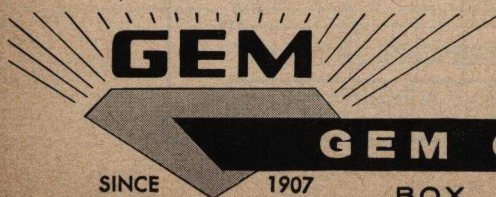
ENGINEERED TO YOUR REQUIREMENTS

... are built for performance and designed for easy, fast installation, highest combustion efficiency for high or low-pressure burners. Send us your prints for special designs or developing new units to reduce assembly costs.



GEM refractory engineers are at your service to help you in developing new units, special refractory shapes or re-designing current pieces to reduce costs, make assembly easier in production.

**MAKERS OF ... COMBUSTION CHAMBERS • RADIANTS •
BACKWALLS • FIRE BRICK • SAGGERS • STOVE
LINERS • HEATING ELEMENTS • VAPORIZER FINS**



GEM CLAY FORMING, INC.

SINCE

1907

BOX 500

• SEBRING, OHIO

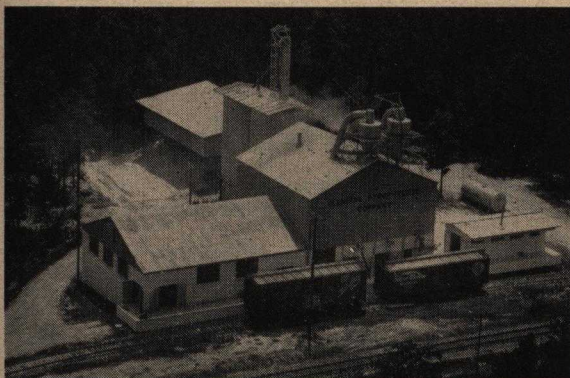
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GLENDON PYROPHYLLITE COMPANY

P. O. Box 2414

Telephone: BRoadway 5-3368
3-3369

Greensboro, North Carolina



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Maintains:

Exploration and Core Drilling Crews under direction of Geological Engineers.

Well equipped physical and chemical laboratories for product control and research.

An experienced technical laboratory staff.

Ceramic engineers in the sales department.

Radio communication system in office, plant, Mines and laboratory.

TO ASSURE YOU THE BEST OF SERVICE AND UNIFORMITY.

GLENDON REFRACTORY GRADE PYROPHYLLITE

For — Shapes — Plastics — Castables

A better low alkali refractory material with unique properties imparting: Dimensional Stability — High Load Strength — Product Uniformity — Economies — Insulation.

TYPICAL CHEMICAL ANALYSIS

SiO ₂	77.0%
Al ₂ O ₃	18.0%
Fe ₂ O ₃	1.0%
Alkalies	.2%
Ign. Loss	3.7%
TOTAL	99.9%

PYROMETRIC CONE EQUIVALENT = 26 PLUS

REDUCES FIRING SHRINKAGE

MODERATE THERMAL EXPANSION

AVAILABLE IN FOLLOWING TYPICAL GRINDS

Grinds	3/4"	1/4"	16	140	200
% On					
1/2"	2				
1/4"	25	0			
8 MESH	48	19	0		
20	63	48	6		
40	70	60	30	0	
100	79	74	54		0
200	90	82	66	4	1
325					4

YOUR INQUIRIES ARE SOLICITED AND SAMPLES WILL BE GLADLY FURNISHED FOR EXPERIMENTAL PURPOSES.

GLENDON HI-AL GRADE PYROPHYLLITE

For — Tiles — Whitewares — Electrical Porcelains

A BODY CONSTITUENT IMPARTING:

Low thermal Expansion

Resistance to dunting

Resistance to crazing

Mild fluxing action

Long firing range

Economies

TYPICAL ANALYSIS

SiO ₂	69.5%
Al ₂ O ₃	23.0%
Fe ₂ O ₃	.6%
CaO	.1%
K ₂ O	.9%
Na ₂ O	1.8%
Ign. Loss	4.2%
TOTAL	100.1%

Though Glendon Hi-Al Pyrophyllite has been offered to the Ceramic Industry for only a few years, its acceptance has been astounding.

Proved crude sources are ample for years and exploration continues.

Open pit mining is practiced and large crude and ground stocks are maintained in the grinding plant.

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Plant Located at—Glendon,
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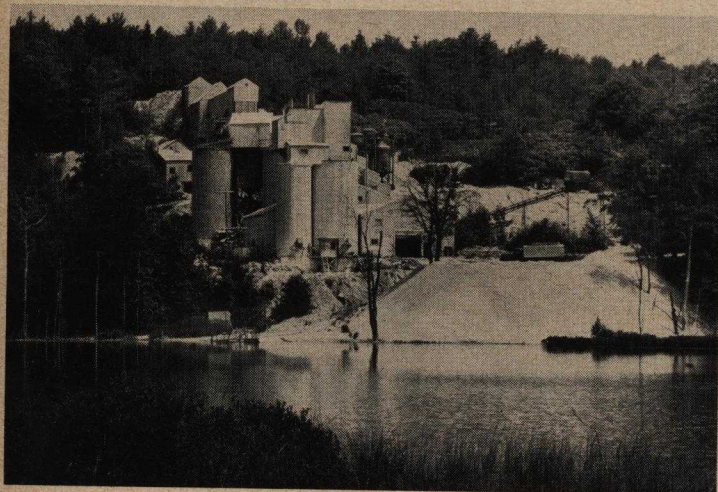
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Produced by our Patented Electrostatic Process



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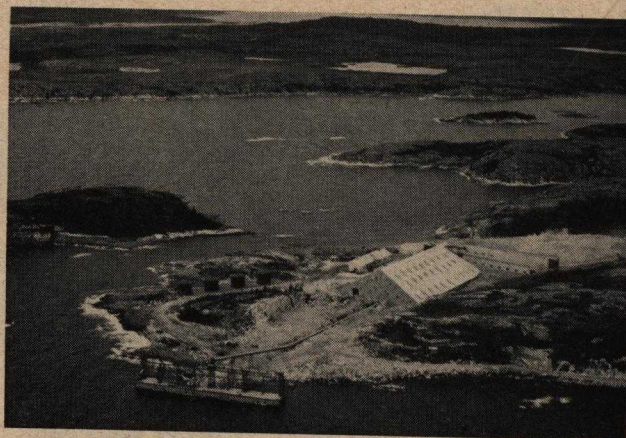
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Shipments of
20-Mesh Feldspar
To Any Port
In the World**

Storage Facilities at Camden, N. J. and other U. S.
Ports for truck and rail delivery to the Glass Industry.

**YOU ARE ASSURED OF MAXIMUM UNIFORMITY WHEN YOU
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"Keene" and "Alstead" 200 Mesh Pottery
Feldspar—Keene, N. H. and Trenton, N. J.
Canadian Granular Feldspar for glass—
Camden, N. J.
Canadian 200 Mesh Pottery Feldspar—
Trenton, N. J.
"Sand-Spar" 20 Mesh (Feldspar Middlings) for
glass—Keene, N. H. and Cape Feldspar, Quebec
Flake Mica—Keene, N. H. and Cape Feldspar,
Quebec



**CAPE FELDSPAR,
QUEBEC, CANADA PLANT**

**CALL OR WRITE GOLDING-KEENE SALES OFFICE
FOR ANALYSIS, SAMPLES AND QUOTATIONS.**

THE GYROMAT CORP.

P. O. Box 600 — Fairfield, Connecticut

The New GYROMAT Ceramic Glazing Equipment

The Gyromat Corporation has recently completed the development of a new high efficiency unit for the production application of vitreous glazes to ceramic ware.

Applying the coatings by a modified air spray technique, its utilization of the liquid glaze closely approaches 100% of theoretical. Its ease of operation and clean up for color change or shut down plus its elimination of expensive and troublesome ventilating equipment are some reasons for its ready acceptance by operating and maintenance personnel.

Reject rate, due to drips, spatters and nozzle plugging has proved to be greatly reduced and those plants which are already operating near the maximum capacity of their air compressing equipment welcome these units, which place no additional drain on the plant air supply.

The schematic print (below) illustrates the reasons for the unit's superior performance.

Here, in Fig. 1, (AA) shows an end view, and Fig. 2 shows a partial view of the enclosed spray chamber.

The ware (E), wall tile, in this case, are shown being carried through the chamber on conveyor (chain) (D). Conveyor and tile enter and leave the chamber through slots in the ends of vestibules (S).

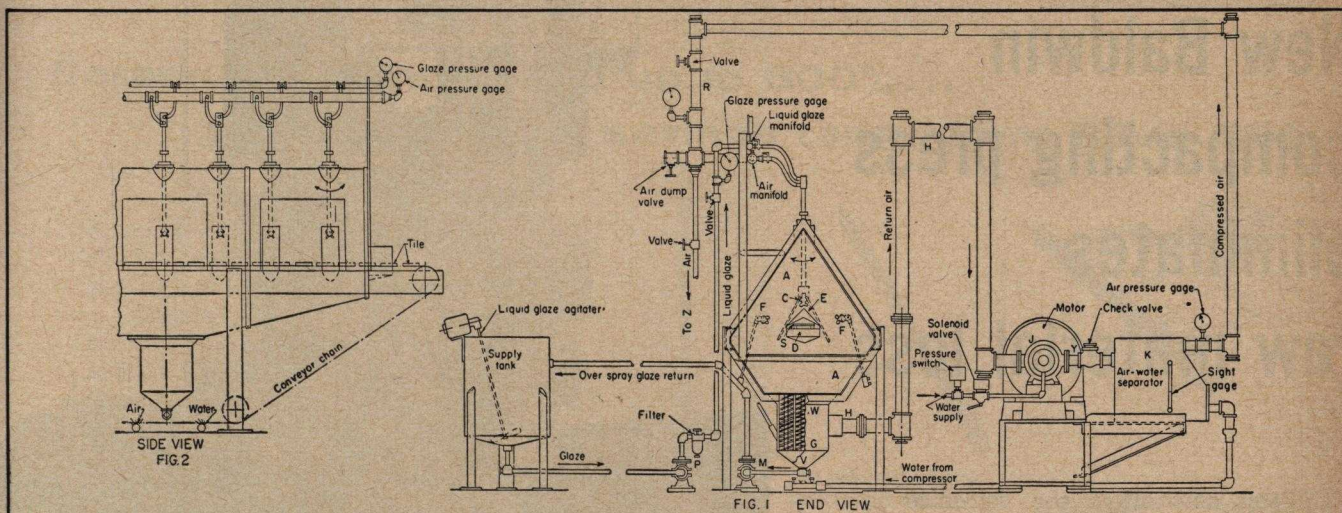
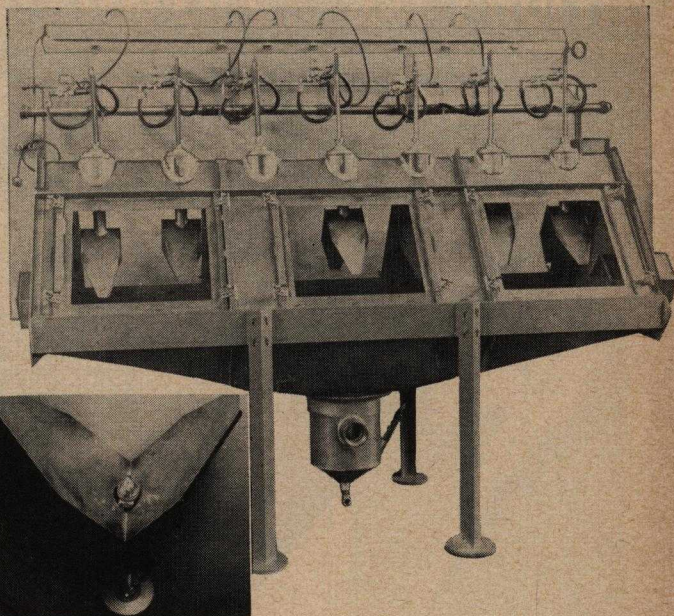
Special air type atomizers, equipped with anti-drip hoods (C) are positioned above the ware for coating flat wall tile. Atomizers (FF') are used when special shaped tile (trim, bull-nosed, etc.) are being coated.

Atomizer adjustment may be made from the exterior of the unit during operation. Glaze material is pumped by motor driven pump (P) from supply tank (L) to glaze manifold and then to respective guns.

Side doors, which during operation are clamped and sealed shut, may be removed for cleaning the unit and setting up the atomizers.

Glaze, which is not deposited on the tile and not suspended in the air in the chamber, collects on the walls and floor of the chamber and drains down through separators (W) in separating chamber (G) to sump (V) where it is drawn off by motor driven pump (M) and returned to glaze tank (L).

The atomizing air, constantly fed into the chamber by the atomizers,



and containing a considerable amount of suspended glaze dust is drawn down through the separators (W) by the compressor suction. Here the glaze dust is separated from the air and combined with the liquid glaze with an efficiency in the order of 99.99%.

This clean air is then returned to the compressor (J) through duct (HHH).

Compressor (J) is a "liquid seal" type which, in the average installation, compresses approximately 110 CFM of air to from 45 to 50 P.S.I. The compressing medium is water which is fed to the compressor at the approximate rate of 2 to 8 G.P.M. depending on the operating conditions.

The water and compressed air, leaving the compressor through duct (Y) are separated in baffled tank (K). The clean dry compressed air then returns to the atomizers through duct (RR).

The water from (K) is employed to wash off the conveyors (D).

A perforated pipe (Z) jets compressed air, from duct (R), onto the conveyor to blow off excess water from washing. This release of a small quantity of air from the system causes "make up" air to be drawn into

the chamber through the slots in the vestibules (SS), thus effectively preventing any "drift" of glaze laden air from the chamber.

The unit is protected against the accidental excessive accumulation of glaze in separating chamber (G) by probe (Y) which operates a solenoid to shut down the system if such a condition should occur.

SUMMARY OF ADVANTAGES:

1. Nearly 100% glaze material utilization—no overspray loss.
2. Consistent, controllable coating with a decrease in rejected ware over conventional air spray equipment.
3. Elimination of exhaust booth and ducts along with the costly maintenance and housekeeping problem.
4. Improved spray gun performance.
5. Simple clean up and color change.
6. Each unit has its own liquid seal compressor that is simple to maintain or even replace. The glazing operation need no longer be dependent on an already overloaded centralized air compressor system.
7. The compressor provides clean, oil-free air.
8. Inherent flexibility in spray gun positioning.
9. Normally, the collected material is returned automatically to the supply tank and does not have to be adjusted for specific gravity.

Other Notes of Interest:

1. The chamber is designed to accommodate the ware and conveyor technique. Above drawing is essentially a schematic.
2. Position and type of air guns are determined for each application.
3. This type of installation can be designed for most production glazing or enameling operations.

THE GYROMAT CORP.

OUR ENGINEERING STAFF IS AVAILABLE FOR CONSULTATION

HAMILTON DIVISION

Baldwin-Lima-Hamilton Corp.

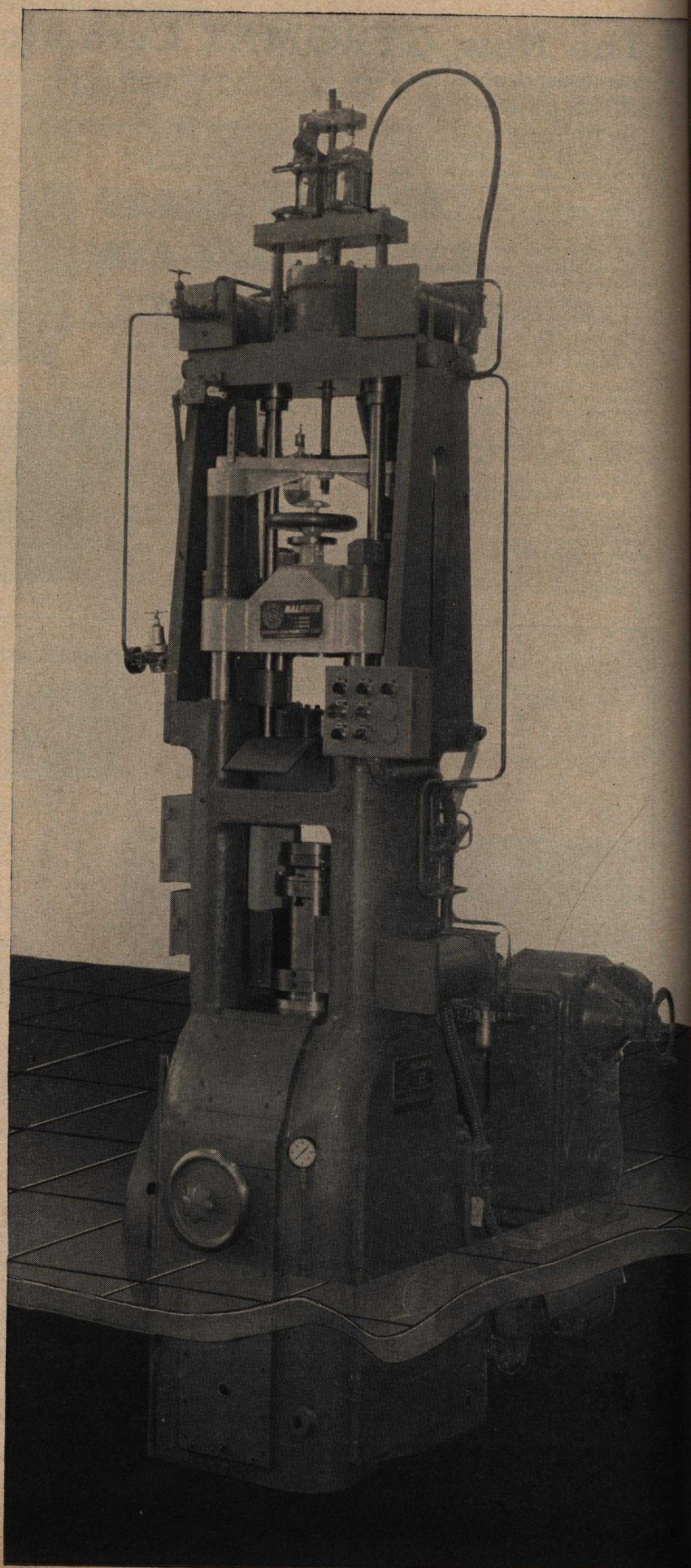
Hamilton, Ohio

New Baldwin compacting press eliminates raw material loss

Hamilton now offers the ceramics industry a compacting press which is completely new in design and virtually eliminates the expense and contamination problem of powder loss of basic raw materials.

This 75-ton compacting machine will process such materials as powdered metals, ceramics, abrasives, carbides, cermetes, ferrites, nuclear and other solid fuels for rockets and missiles with unprecedented speed and quality.

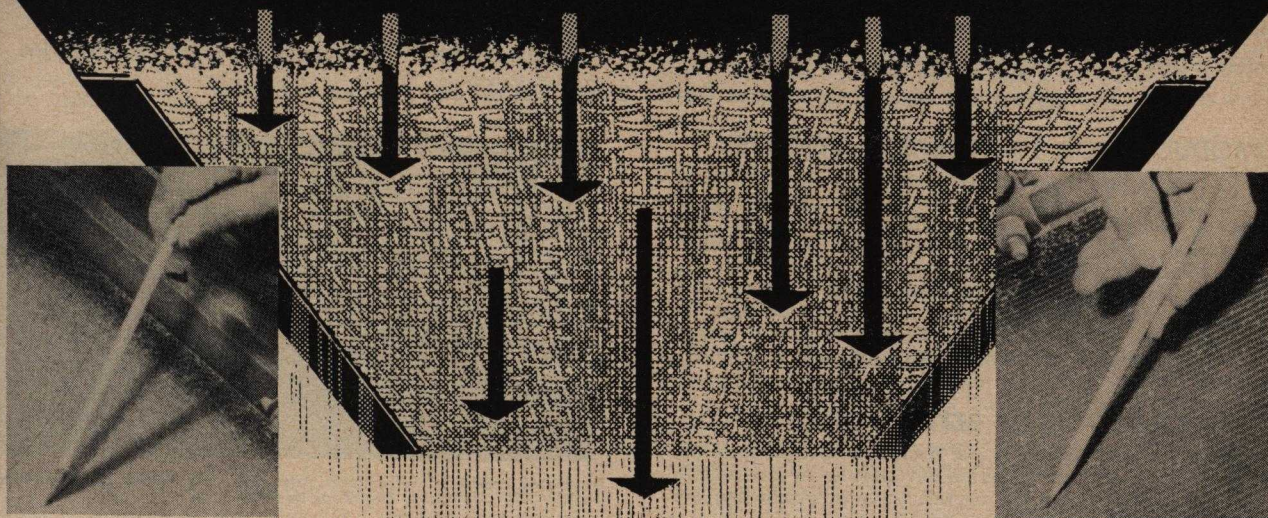
Another important advantage is that tools from Baldwin's famous 20-A compacting press are interchangeable with those of this new 75-A, and—with adapters—tools from other presses can also be used.



F. R. HANNON & SONS

1605 WAYNESBURG ROAD S. E., CANTON 7, OHIO

you get a **"NEW LEASE ON SCREEN LIFE"...** *and* **PROFITS**
with **HANCO ELECTRIC SCREEN HEATERS**



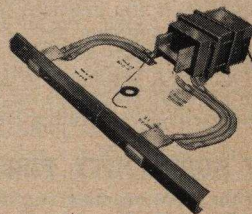
Screen life is increased up to 800%...

preparation cost savings range from 30 to 50%

Hanco, the first practical answer to economical, efficient screening, eliminates blinding and clogging for full capacity, uninterrupted production... eliminates "returns" and cleaning labor... minimizes screen replacement down time. In addition, you get...

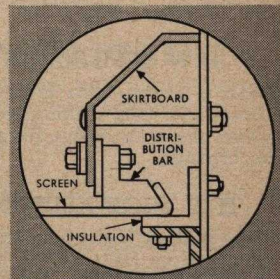
- ★ Low Operating Cost... just 15c an hour for a 4x5' screen at 1c per KWH.
- ★ Fast, easy installation... assembled, thoroughly tested and pre-set by trained electrical workers before shipment.
- ★ Safety... secondary low voltage eliminates fire or shock hazard.

Maximum adaptability... to practically any capacity... any new or existing woven screen, steel cloth installation.



THE "COMPLETE HANCO PACKAGE" IS FACTORY ASSEMBLED, TESTED AND PRE-SET.

EXCLUSIVE PATENTED QUICK-CHANGE ATTACHMENT MINIMIZES SCREEN REPLACEMENT TIME... GUARDS DISTRIBUTION BARS AND INSULATION FROM ABRASION.



Write for a **HANCO** *laboratory-proven solution to your screening problems*

**Recommended and used by America's leading screen manufacturers
for ACCURACY - CAPACITY and ECONOMY**

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PRODUCTS FOR THE CERAMIC INDUSTRY

Harbison-Walker manufactures a complete line of refractories for all industries. For the ceramic industries there are H-W products for use in periodic kilns, continuous tunnel kilns, frit and enameling furnaces, cement kilns, muffle furnaces, boiler furnaces, glass tank furnaces and others.

Plants for the manufacture of Harbison-Walker refractories are located in the States of Alabama, California, Colorado, Indiana, Kentucky, Maryland, Michigan, Missouri, New Jersey, Ohio, Pennsylvania, Texas and Washington, and in Canada, Mexico and Peru.

SELECTION OF REFRACTORIES

The true cost of refractories is not measured by their cost per thousand brick. The proper criterion for the value of a refractory material is its effect upon the overall costs of production per unit of output.

The costs of handling and bricklaying, and generally the cost of transportation, amount to as much for inferior brick as for those of high quality.

H-W FIRECLAY REFRACTORIES

High Duty - Medium Duty - Low Duty Brick
Of Highest Quality - Rigidly Controlled

Harbison-Walker has extensive reserves of clays adapted to the manufacture of superior high duty refractories. By scientific blending of these clays and by variations in the methods of processing, high duty brick are produced having a wide range of desirable physical properties, in various combinations especially suited for particular operating conditions.

H-W SUPER-DUTY FIRECLAY REFRACTORIES

To meet the more exacting requirements of modern furnace practice, Harbison-Walker has developed the super-duty fireclay brands ALAMO, VARNON, BOONE, KENMORE, DEAN, H-W KALA and H-W SUPER SAVAGE. They fill a definite need in applications where the conditions exceed the limits for high duty fireclay brick.

H-W SEMI-SILICA FIRECLAY BRICK

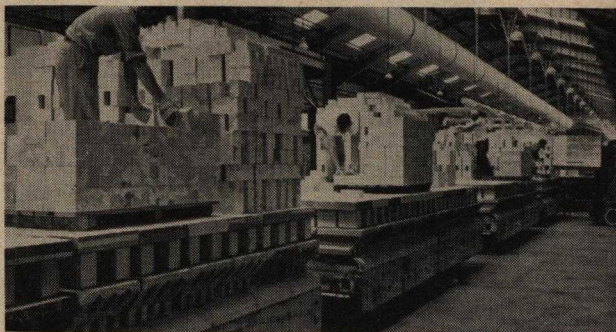
KAOSIL is a semi-silica fireclay refractory of superior quality which excels for long soaking heats in ceramic kilns and furnaces. It is particularly applicable for piers, for heavily insulated walls and for crowns.

H-W HIGH-ALUMINA REFRACTORIES

Harbison-Walker high-alumina brands include all the commercial classes from 50% to 99+ alumina. High-alumina brick are more refractory than are fireclay or kaolin brick, approximately in proportion to their content of alumina. H-W high-alumina brands comprise the following: DIALITE 50%, H-W SPECIAL H.A. 50%, ALCOR XX 60%, ANCHOR 60%, H-W MULLITE 70%, ALUSITE 70%, CORALITE 80%, CORALITE XX 85%, KORUNDAL 90%, H-W CORUNDUM 99%.

H-W MULLITE

H-W MULLITE consists essentially of the mineral mullite. It has outstanding load-bearing properties and volume stability at high temperatures. It is used in glass-melting furnaces, electric steel furnace roofs and in other high temperature furnaces where severe conditions prevail.



Unloading hard-fired refractories from kiln cars. Note Harbison-Walker Car Tops in foreground.

H-W SILICON CARBIDE BRICK

H-W SILICON CARBIDE brick possess some measurably enhanced physical properties of major importance. Many sizes and shapes are formed by impact under great pressure, resulting in the achievement of the most homogeneous texture with higher density and strength.

High temperature firing in a closely controlled atmosphere contributes to the formation of an exceedingly impervious surface and lower permeability. These properties improve resistance to the objectionable oxidation which always is accompanied by volume increase and loss in strength.

H-W ZIRCON REFRACTORIES

H-W ZIRCON brick and H-W ZIRCON mortar (air setting) are used with particular advantage in various specific applications. Because of the zircon composition, these refractories are highly resistant to corrosion by fluxes such as molten glass batch and volatile alkalis. For use in the glass industry, these properties commend the H-W Zircon for paving glass furnace floors and for use in certain other positions that are exposed to severe conditions. The high resistance of H-W Zircon to wetting by molten aluminum accounts for its economical use at the metal line of some furnaces.

H-W SILICA REFRACTORIES

Harbison-Walker brands of silica brick comprise the following: STAR for usual applications and VEGA for super-duty service. The desirable combination of properties are high refractoriness; great mechanical strength and resistance to abrasion at high temperature; high thermal conductivity; and a definite thermal expansion which insures tight joints in the furnace structure. H-W R brand is intermediate in refractoriness and in some applications is used with special benefit.

SOME H-W BASIC REFRACTORIES

M-W MAGNESITE and H-W PERIKLASE brick fulfill the most exacting requirements where high temperatures and strongly basic slags are involved.

METALKASE which are pre-formed under great pressure and by welding are firmly encased in steel on either three or four sides. They are also supplied in various modifications in any burned or chemically bonded basic composition with internal plates. These brick are used in furnaces in which the linings are subjected to the corrosive action of basic slags and spalling conditions.

MAGNECON and THERMAG are hard-burned magnesite-chrome brick which are particularly adapted for linings of high temperature zones of rotary cement kilns.

MAGNEX and CHROMEX (chemically bonded) and CHROMEX B (hard fired) basic brick, provide compositions and various physical properties for making the best selections needed for a wide range of severe operating conditions.

FORSTERITE and FORSTERITE L brick consist essentially of the magnesium-silicate mineral forsterite. Their outstanding characteristics are their stability and strength at high temperatures. They are used extensively for regenerator walls, arches, checker settings and port construction in glass tanks.

H-W brands of complementary physical and chemical properties to those long established and regarded as standards are commercially available.

H-W INSULATING REFRACTORIES

Harbison-Walker insulating fire brick are manufactured in various classes for use as refractory linings or as back-up insulation. Each brand has the correct balance of thermal and physical properties for the service for which it is recommended. These brands provide the most desirable combinations of light weight, structural strength, high insulating value and low heat storage capacity. Brands include H-W 16 (1600°F.), H-W 20 (2000°F.), H-W 23 (2300°F.), H-W 26 (2600°F.), H-W 28 (2800°F.), H-W 30 (3000°F.) and VEGALITE (3000°F.). Temperatures shown indicate approximate service limit.

VEGALITE is the unique silica insulating refractory which is particularly suited for insulating silica caps of glass tanks.

LOTHERM is an unusual insulating refractory developed specifically to meet the requirements of high physical strength and good insulating value. It is used for rotary cement kiln liners, insulation for glass tank flux blocks, combustion chambers of oil-fired domestic furnaces and other applications.

H-W BLOCK INSULATION is a lightweight mineral fiber block insulation for service up to 1700°F.

H-W MINERAL FIBER COATING is composed of mineral wool combined with asbestos fiber and a strong adhesive binder which forms a resilient insulating coating.

H-W FINISHING CEMENT is a blend of mineral wool fibers, a hydraulic setting binder and plasticizers suited for covering the external surface of H-W Block Insulation.

ACID-PROOF BRICK AND TILE

DURO and W-ACID acid-proof brick and tile are dense, vitreous, and strongly resistant to the action of mineral and organic acids and various other chemicals. The refractoriness is unusually high for acid-resisting material.

H-W RAMMING MATERIALS

THERMOLITH BATCH (Dry) and PLASTIC THERMOLITH BATCH are refractory chrome ore base materials. They are used as ramming materials to form dense, well bonded, monolithic furnace bottoms and linings.

CORALITE RAMMING MIX is a high-alumina monolith forming refractory with exceptionally high refractoriness. It has a P.C.E. in excess of Cone 37 and is shipped in wet form. The material as shipped is ready for use.

KORUNDAL RAMMING MIXTURE is a high-alumina material of unusual refractoriness which has excellent strength at high temperatures.

H-W C MIX (High purity Seawater Periclase) used for contour-rammed open hearth and electric furnace bottoms greatly reduces furnace down time, saves labor and avoids burning-in sacrifice of refractory superstructure. And with its measurable margin of superior properties, costs are decidedly lower and furnace availability is greatly increased.

H-W MAGNAMIX of 80% content, stabilized as periclase, is made from dead-burned Washington magnesite. While H-W Magnamix is dependable for making new bottoms, it is especially adapted for bank maintenance, patching deep holes and repiping tap holes.

HARCOR RAMMING MIX (shipped in sacks of 100 lbs. net weight) is a high-alumina monolithic refractory which when mixed with water and rammed in place develops a phenomenal strength upon drying. In addition to these several ramming materials, Harbison-Walker manufactures various others which are especially suited for certain particular requirements.

H-W CASTABLE REFRACTORIES

H-W STANDARD CASTABLE when mixed with the proper amount of water, forms refractory concrete in easy-to-use form. It serves for pouring baffles, arches, walls, door linings and hearths, and is used also for forming special shapes and domestic furnace hearths. It is air setting, having a strong hydraulic bond.

H-W SUPER CASTABLE is used in applications where the temperatures are higher than that for which standard castables are suitable.

H-W 56 LIGHTWEIGHT CASTABLE is a high grade insulating refractory combining the properties of light weight and strength to an unusual degree. Approximately 56 lbs. are required per cubic foot of construction. It has excellent workability and can be molded, cast in place, troweled, or gun-applied with equally good results.

H-W 85 LIGHTWEIGHT CASTABLE is similar to H-W 56 Lightweight Castable except that it weighs about 85 lbs. per cubic foot in place, can be used at higher temperatures and has greater strength.

H-W LIGHTWEIGHT CASTABLE 2600 is a unique high temperature lightweight castable having excellent volume stability and density closely corresponding to insulating brick. It is used for annealing and heat treating furnace walls, doors and roofs, and has other high temperature uses.

H-W HIGH-ALUMINA CASTABLE is an alumina base, hydraulic setting refractory concrete. It can be cast or poured in place and is capable of withstanding operating temperatures of 3100°F.

H-W EXTRA STRENGTH CASTABLE has been developed for those applications requiring a material of greater strength and additional abrasion resistance such as tunnel kiln car tops, hot blast mains and boiler furnace ash-pits.

H-W CASTABLE-RC is a relatively low-cost castable for intermediate duty service, such as paving around furnaces, low and intermediate flues, storage floors for hot products and many similar applications.

H-W HARCAST is highly resistant to reducing conditions with a ferric oxide content of less than 0.5%. It has exceptional strength and abrasion resistance at all temperatures up to its service limit of approximately 2800°F.

H-W PLASTIC FIRE BRICK

H-W STANDARD PLASTIC FIRE BRICK, which is ready for use as shipped, is of a dense uniform composition of high grade fire clays corresponding to mixtures used for making high duty fireclay brick. It is used for complete or partial monolithic furnace linings, door linings and burner blocks.

APACHE is a high-alumina plastic refractory for most severe conditions at high temperatures. It offers high resistance to active fluxes and is used in many miscellaneous furnaces.

H-W SUPER PLASTIC FIRE BRICK provides the properties of super-duty fireclay refractories in plastic form.

H-W SUPER PLASTICS-CS is a cold setting super plastic fire brick. The strength of H-W Super Plastic-CS, after drying in the low temperature range, is much greater than that of ordinary super plastic fire brick.

H-W MORTAR MATERIALS

The selection of the proper bonding mortar from the various Harbison-Walker brands is as important as is the selection of the brick.

HOT SETTING BONDING MORTARS

A hot setting bonding mortar does not have air setting properties but develops a strong bond at furnace temperatures. Among the outstanding products of this class are H-W FINE GROUND FIRE CLAY, H-W SPECIAL MORTAR MIX, H-W SUPER-DUTY FIRECLAY, ANKORITE 65, STAR SILICA CLAY, STAR BOND, VEGA BOND and R-W SILLIMANITE.

COLD SETTING BONDING MORTARS

Cold setting bonding mortars develop a very strong bond merely upon drying. Outstanding among these are HARWACO BOND (Diaspore Base), FIREBOND (Silica Base), THERMOLITH (Chrome Ore Base) and KORUNDAL BONDING MORTAR (High-Alumina Base).

All kinds of special clays and granular materials including synthetic H-W MULLITE GRAINS.

HARBISON-WALKER REFRACTORIES COMPANY

And Subsidiaries

World's Most Complete Refractories Service
General Offices: Pittsburgh 22, Penna.

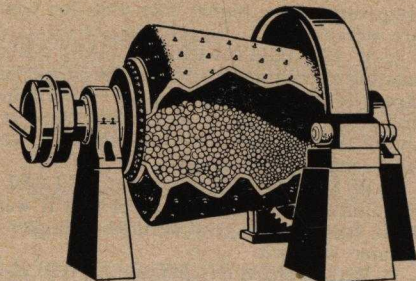
HARDINGE COMPANY INCORPORATED

YORK, PENNSYLVANIA

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • Jacksonville Beach • Birmingham • San Francisco

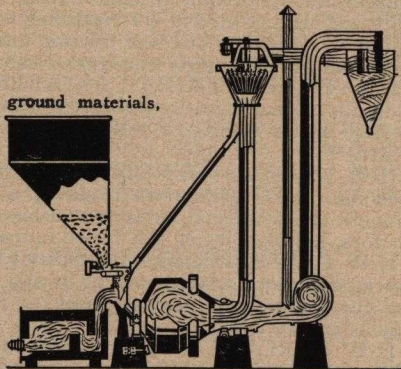
Conical and Tricone Grinding Mills

Conical and Tricone Ball and Pebble Mills are used for grinding wet or dry, in open or in closed circuit, either for granular or fine products. The shape of these mills causes a rapid circulating and classifying action, which increases capacity for power expended over other types. Sizes 2 to 12 ft.; capacities a few pounds per hour to 50 tons. Bulletin No. AH-389-51 for wet grinding; 17-C-51-dry grinding; AH-414-51-Tricone.



For separation of finely ground materials,

the Hardinge "Gyrotor" Air Classifier, in conjunction with the Hardinge Mill, is a compact self-contained unit providing extremely close control of product over a wide range, down to micron fineness. The material is conveyed to any convenient height in the building. When the Hardinge Air Heater is used with this unit, feeds up to 50% moisture may be ground without independent dryer. Bulletin 17-C-51.



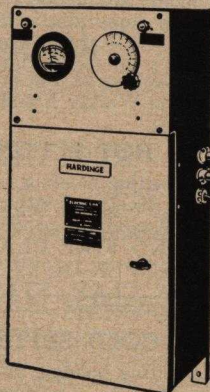
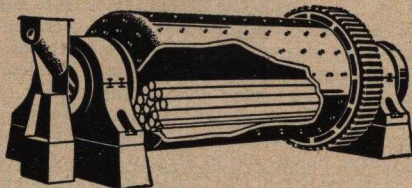
Cylindrical, Rod, Tube and Batch Mills

The Conical-Head Rod Mill is used for a granular product, between 10 and 48-mesh, with a minimum of fines, grinding wet or dry. Sizes 3 to 12 ft. in diameter. Bulletin No. 25-C-51.

For a finished product in one operation without the use of classifiers, long Tube Mills are sometimes used. Bulletin No. 18-B-51.

Convex-Head Cylindrical Mills provide reduced head liner wear due to shape of heads. Bulletin AH-389-51.

Batch milling is necessary where long-time grinding alone will give the desired product or where several different products must be handled without one contaminating the other. The Convex-Head Batch Mill produces equivalent results to that of cylindrical batch mills in less time because of the more intensive circulating action of balls and material.

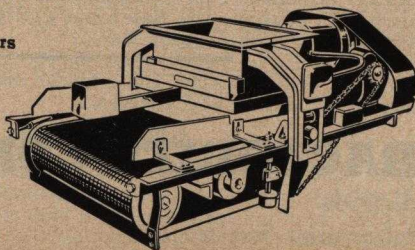


"Electric Ear"

A revolutionary principle of control that automatically regulates the feed rate of a mill to keep it operating at maximum efficiency by "listening" to the sound. It compensates for changes in grindability due to variation in hardness, size of feed, etc. The product is more uniform and the mill capacity is increased 10% to 20% by its use alone. It functions equally well on both wet and dry grinding mills. Bulletin No. 42-A-51.

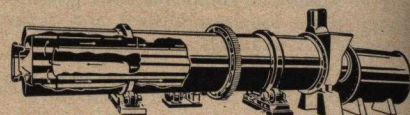
Constant-Weight Feeders

The Hardinge Constant-Weight Feeder measures and feeds by weight instead of volume, eliminating variations due to specific gravity or changes in size of material. It feeds coarse or fine materials without choking, and operates successfully with rolls, crushers, ball mills, dryers, kilns, mixers, conveyors and like equipment. Capacities range from 1 lb. an hour to 1000 tons. Bulletin No. 33-E-51.



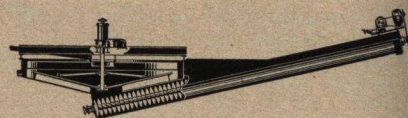
Ruggles-Coles Dryers, Kilns and Coolers

There are seven distinct types of Ruggles-Coles Double and Single Shell Rotary Dryers, designed for direct, indirect and steam heat in from four to ten sizes for each type. Also rotary and vertical kilns; water-tube, partially submerged and direct-contact rotary coolers. Bulletin No. 16-D-51.



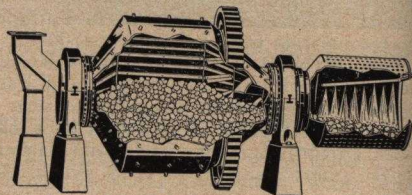
Hydro-Classifiers

The Hardinge Hydro-Classifier uses a spiral scraper to convey the oversize to a discharge cone in the bottom where wash water is introduced in such a manner as to cause a centrifugal action which effectively cleans the coarser particles discharged. The fines overflow the rim. The underflow is discharged through a valve in the center of the tank bottom, or is dewatered and elevated by an enclosed screw. Separations from 48 to 400-mesh and finer. Capacities range from a few pounds to over 100 tons per hour. Bulletin 39-B-51.



Scrubbers

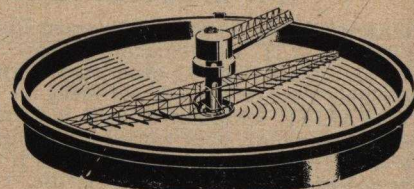
The Hardinge Conical Scrubber cleans by "mass action" and natural displacement. This action removes dirt and silt without wear on the Scrubber. The classifying action of the cone holds back the large clay balls until properly disintegrated. Foreign materials, such as sticks, vegetation, etc., can do no harm. Power and water requirements are lower than with other methods. Repair costs negligible. Bulletin No. 37-B-51.



Thickeners, Clarifiers, Sand Filters, Agitators

The Hardinge Thickener and Clarifier is designed for the separation of mixtures of liquids and fine suspended matter. One distinctive development of this machine is the spiral scraper, which cleans the bottom of the tank with each revolution. Bulletin No. 31-E-51.

The Sand Filter is essentially the same mechanism as the thickener, except that it is provided with a sand filter bed. This machine is particularly applicable for "final clarification" problems. The filter bed is kept constantly active by the spiral scraper, which cleans the entire bed. Bulletin 30-B-51.

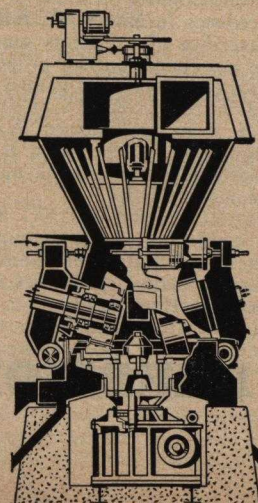


Another Hardinge Filter is the automatic backwash high rate type—a self-cleaning filter which requires little attention in operation. Bulletin 46-A-51.

Hardinge Agitators are driven through completely enclosed mechanisms running on ball bearings in oil. Pulp is circulated by an air lift in the hollow central drive shaft. The raising winch is above the mechanism away from splash. The agitator arms are extra heavy. Bulletin 31-E-51.

Disc-Roll Mills

The Hardinge Disc-Roll Mill is a roller-type mill with two adjustable, pneumatically loaded rolls for grinding material on a rotating disc or table (Loesche type). The Hardinge "Gyrotor" Air Classifier, in combination with the mill, provides a complete grinding, classifying and drying system. Particularly suited for efficient grinding of limestone, coal, phosphate rock, bauxite, talc, clay, celestite, gypsum, raw cement mix, etc. Bulletin No. 52-51.



THE HARSHAW CHEMICAL COMPANY

1945 East 97th Street, Cleveland 6, Ohio



COLORS

Harshaw makes every type of ceramic color for enamels, glass, pottery and tile. Controlled, large scale production assures low costs, strong uniform shades, as well as prompt delivery service not only on standard colors but also on a large variety of unusual ones.



CHEMICALS

Practically every chemical or mineral used in ceramics can be obtained from Harshaw without delay: Heavy chemicals, such as soda ash or mineral acids; intermediate chemicals, such as copper oxide.



OPACIFIERS

The manufacture of opacifiers is a Harshaw specialty. These include antimony oxide, tin oxide and Uverite. In addition, many special-purpose compositions are available.

On all its products for the ceramic industry, Harshaw is continuing its aggressive research program to develop and improve materials to meet the increasingly high requirements of the industry.

Some of the Harshaw Materials Used by the Ceramic Industry

Aluminum Oxide
Aluminum Hydrate
Ammonium Bifluoride
Ammonium Carbonate
Antimony Oxide
Antimony Sulfide

Barium Carbonate
Bone Ash
Borax
Borax Glass
Boric Acid

Cadmium Carbonate
Cadmium Oxide
Cadmium Sulfide
Calcium Carbonate
Calcspars
Cerium Hydrate
Chalk
China Clay
Cobalt Carbonate
Cobalt Chloride
Cobalt Nitrate
Cobalt Oxide
Cobalt Sulfate
Colors, Ceramic

Colors, Overglaze
Colors, Underglaze
Copperas
Copper, Black Oxide
Copper Carbonate
Copper Hydrate
Copper, Red Oxide
Cryolite

Dextrine
Enamel Oxides
Enamels, Glass
Epsom Salts

Feldspar
Flint
Fluorspar
Glauber's Salts
Glazes
Ground Glass
Gum Arabic
Gum Tragacanth
Gold, Liquid Bright

Hydrofluoric Acid
Hydrofluosilicic Acid

Iron Oxide
Iron Perchloride

Kaolin

Lead Carbonate
Lead Oxide
Lead Silicates
Litharge

Magnesium Carbonate
Manganese Carbonate
Manganese Chloride
Manganese Oxide
Manganese Sulfate

Nickel Carbonate
Nickel Chloride
Nickel Oxide
Nickel Salts
Nitre

Paris White
Plaster of Paris
Potash Carbonate
Potassium Bichromate
Potassium Nitrate
Powder Blue

Red Lead
Rochelle Salts

Salt Cake
Saltpetre
Silica
Soda Ash
Soda Caustic
Sodium Aluminate
Sodium Bichromate
Sodium Bisulfate
Sodium Carboxy-Methyl-Cellulose
Sodium Nitrate
Sodium Nitrite
Sodium Fluoride
Sodium Pyrophosphate
Sodium Silicate
Sodium Silico Fluoride
Sodium Sulfate
Stains, Body
Stains, Glaze
Strontium Carbonate

Talc
Tin Oxide
Uverite

Wetting Agents

Whiting

Zinc Oxide

AND HERE'S WHERE TO GET THEM

BRANCHES

Chicago 32, Ill., 4925 So. California Ave.
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New York 6, Hastings-on-Hudson
Philadelphia 48, Pa., Jackson & Swanson Streets
Pittsburgh 22, Pa., 6th St. and Fort Duquesne Blvd.



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Seattle 4, Wash., Great Western Chemical Co., 6921 East Marginal Way
Spokane 8, Wash., Spokane Pres-To-Log Co., W. 1133 College Ave.
Chattanooga 2, Tenn., Peirson-Deakins Company, 823-24 Chattanooga Bank Bldg.

THE HARRIS CLAY COMPANY

Main Office, Plants, and Mines

Telephone: POplar 5-4251

SPRUCE PINE, N. C.

North Carolina PRIMARY KAOLINS

Long known for their low Iron content, low Titanium content, and Uniformity. Only North Carolina primary kaolins are known to contain significant disseminated amounts of the clay mineral Halloysite.

KAMEC

Time Tests have proven that the use of Kamec kaolin in ELECTRICAL PORCELAIN insures uniformity and purity necessary for the best electrical properties.

The superior physical properties of Kamec kaolin have also made it a favorite in the manufacture of SEMI-VITREOUS WARE.

TYPICAL CHEMICAL ANALYSIS

SiO ₂	46.03%
Al ₂ O ₃	37.30%
Fe ₂ O ₃	1.20%
TiO ₂	.08%
K ₂ O	1.00%
Na ₂ O	.10%
Loss on Ignition	13.75%
	99.46%

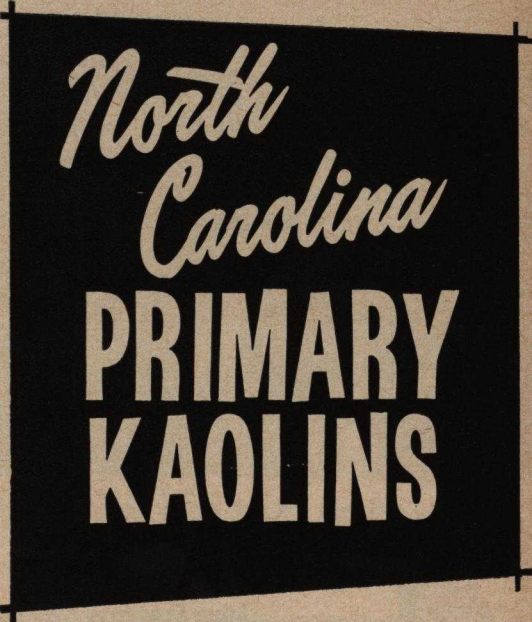
LUNDAY

Time Tests have proven that Lunday is a necessity in the best thermal shock resisting GLAZES. A favorite in the manufacture of SANITARY WARE, based on the mechanical shock resistance and color properties derived by its use.

All are White Firing "SAFETY" Clays which Improve Bodies, Control Warpage, and Reduce Production Losses.

A TRIAL WILL CONVINCE YOU — YOUR INQUIRIES ARE INVITED

Our products have been time tested since 1888, and consumer proven by 70 years of service to the Ceramic Industry. Your future needs are assured by ample reserve supplies, modern wet process production, technical laboratory controls, reliable, prompt service and shipment.



LUNDAY

TYPICAL CHEMICAL ANALYSIS

SiO ₂	46.38%
Al ₂ O ₃	37.02%
Fe ₂ O ₃	1.03%
TiO ₂	.08%
K ₂ O.....	1.04%
Na ₂ O	.15%
Loss on Ignition	13.93%
	99.63%

SPARKS

Time Tests have proven that Sparks imparts the color and physical qualities so vital in the manufacture of finest CHINAWARE and other VITREOUS ceramic products.

TYPICAL CHEMICAL ANALYSIS

SiO ₂	45.98%
Al ₂ O ₃	37.51%
Fe ₂ O ₃	.80%
TiO ₂	.06%
K ₂ O.....	.85%
Na ₂ O	.12%
Loss on Ignition	14.00%
	99.32%



SPRUCE PINE, NORTH CAROLINA
POplar 5-4251

HAUCK MANUFACTURING COMPANY

COMBUSTION ENGINEERS — ESTABLISHED 1900

133-134 TENTH STREET ● BROOKLYN 15, N. Y.

CHICAGO 44, ILL., 4657 W. HARRISON STREET

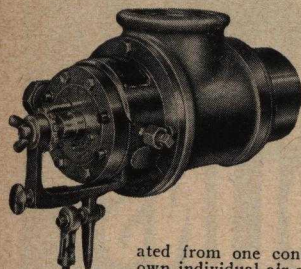
SAN FRANCISCO 7, CAL., 625 THIRD STREET

and Sales Representatives in Other Principal Cities

Manufacturers of Gas and Oil Burners and Equipment for Kilns, Dryers, Lehrs and Furnaces

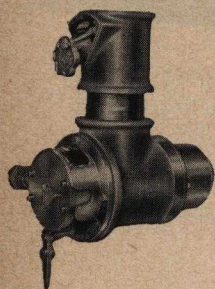
OIL BURNING EQUIPMENT

Proportioning Oil Burners



Automatically proportion and maintain correct, straight-line air-oil ratio with accurate temperature control over wide operating range. Single lever controls both the oil and low pressure air at the same time, in automatic or manual operation. Eliminate relying on men to maintain quality of combustion. A battery of burners may be operated from one control motor, with each burner being its own individual air-oil mixer, not affecting the other burners in the group. Catalog 410.

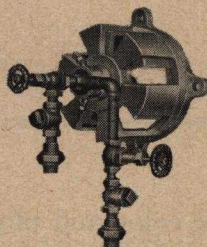
Low Pressure Oil Burners



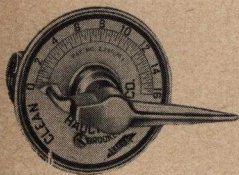
For individual control of oil and low pressure air. Wide range of firing capacity. With easy starting and regulating. One lever controls air for perfect oil atomization. Indicator dial eliminates guesswork. Burn any grade of fuel oil; save oil; reduce carbon formation. Brick plants report the Series "B" Burners give the best burns and the most economical performance in all their experience with oil burners. Catalog 409.

High Pressure Oil Burners

For use with steam or compressed air at 30 p.s.i. pressure and higher, to atomize all grades of fuel oil. The fine atomization of oil by the Hauck Venturi results in high oil-burning efficiencies, a cleaner, hotter flame; instantaneous and trouble-free lighting—without smoke; unusually easy control from low to medium and high oil-burning capacities; substantial saving in oil. Cylindrical, conical and flat flame types. Catalog 456.



Micro-Control Oil Valves

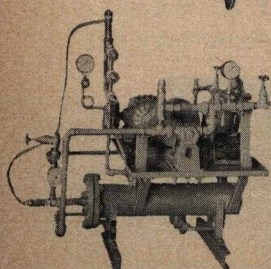


Provide positive, speedy, uniform, graduated control of oil flow to burners. Eliminate uncertainty as to flow regulation, and assure duplication of valve settings, saving time and fuel, and improving combustion conditions. Made in Micro-Cam type in $\frac{1}{4}$ " to 1" pipe size, and in Self-Cleaning Metering type in $\frac{1}{4}$ " and $\frac{3}{8}$ " sizes. Both are available with lever or wheel handle. Catalogs 704A and 707A.

Fuel Oil Heaters and Preheaters

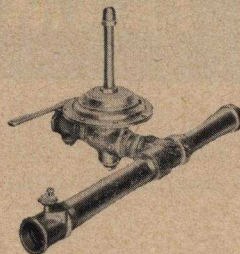


For heating heavy oil to required temperature for satisfactory pumping, Hauck oil tank suction heaters are made in steam (above) and electric types. For raising oil from pumping temperature to higher temperatures required at the burner, Hauck oil preheaters are made in steam and electric types for automatic temperature control. Catalogs 709 and 714. Also assembled heavy oil heating and circulating unit (shown at left), with circulating pump on portable base. Catalog 718.



GAS BURNING EQUIPMENT

Low Pressure Air-Gas Proportional Mixers



Made for single valve control with automatic proportioning of air and gas to any desired ratio. Ideal for manual or automatic firing control applications. Catalog 805A.

High Pressure Gas-Air Inspirators

Utilize gas at 1 to 30 lbs. pressure to inspire the air required for combustion. Wide range of gas capacity with constant gas-air ratio is obtained with a single valve control of gas pressure. Catalog 806A.



Gas Burner Nozzles

For blast firing gas mixtures in an open port or without a combustion chamber, Hauck "Retain-a-Flame" Nozzles, straight or elbow types operate with minimum turbulence in main stream and produce long, cylindrical torch flames. Catalog 804C.



For installations requiring constant atmospheric condition, Hauck "Sealed-in" Nozzles provide high combustion efficiency. Tunnel burners are available as assembled units of sealed-in nozzles, refractory combustion tunnels and burner mounting boxes. Catalog 807.

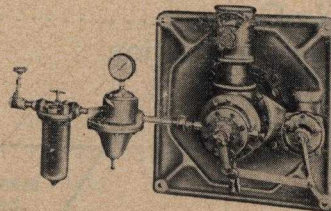
Vari-Pressure Burners

Burn oil or gas with low pressure air. Ideal for multiple burnered kilns and furnaces where air-fuel ratio and capacities are controlled by varying of pressures from one point for a group of burners. Flame adjusting lever permits long or short flame operation. Catalog 413.



Oil Atomizing Inserts

For standby firing with oil, when gas is in short supply. Easily installed in nozzles or tees of many high or low pressure gas burners. Equipped with self-clean, micrometering control oil valve. Catalog 715.

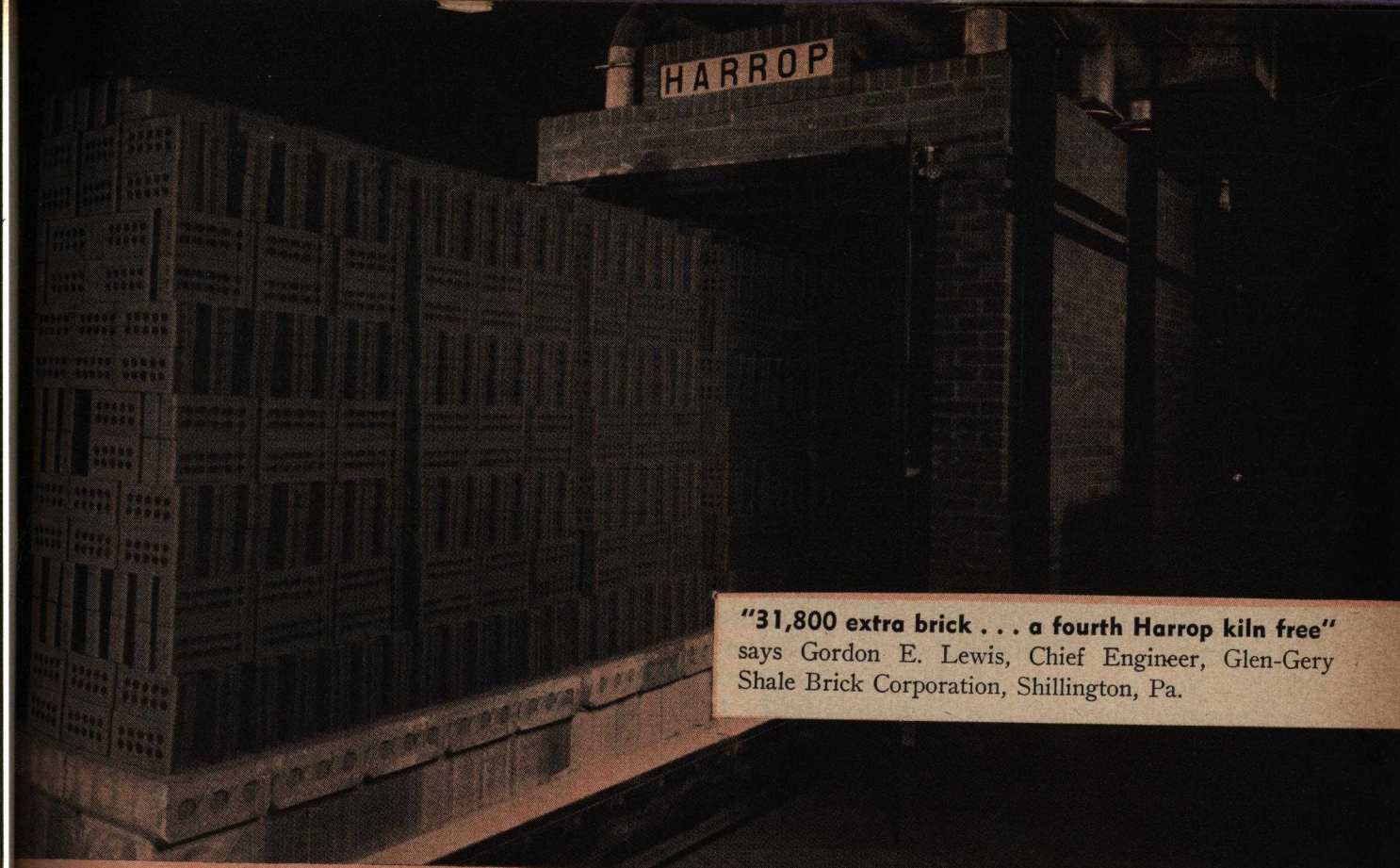


Combination Gas and Oil Burners

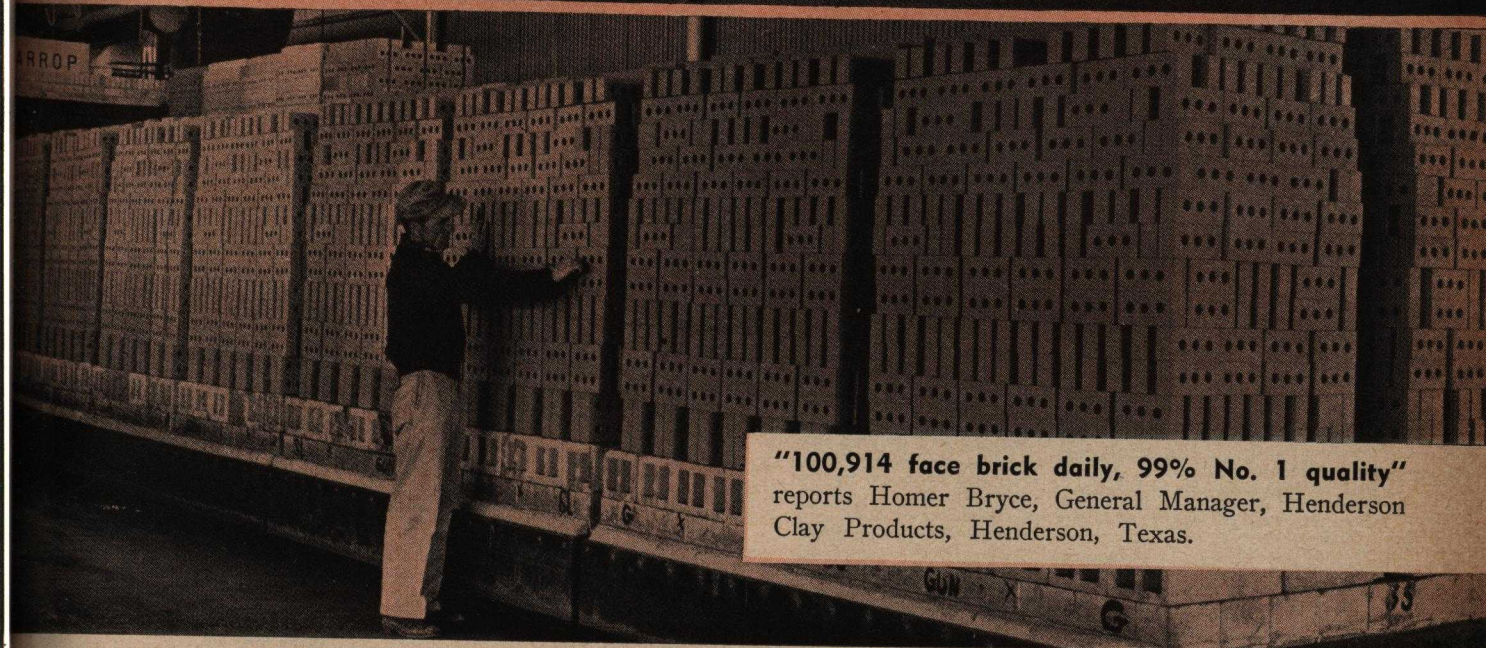
Burn either fuel with equally good combustion and efficiency in a wide range of capacity. Instant switching from one fuel to the other. One control lever regulates and automatically proportions flow of gas or oil and air. Also available with individual control valves. Catalog 408A.

OTHER HAUCK PRODUCTS

Burner Mounting Plates and Brackets, Blowers, Pumps, Oil Strainers, Automatic Shut-Off Valves, Pressure Relief Valves, Oil Temperature Regulators and Thermometers. Oil or Gas Torch Burner equipments of all types for heating and repair work, lighting coal fires, melting, thawing. Melting kettles for tar, asphalt, lead, compound, etc. Oil Inserts for gas burners, Adjustable Flow Valves for gas or air, etc.



"31,800 extra brick . . . a fourth Harrop kiln free"
says Gordon E. Lewis, Chief Engineer, Glen-Gery
Shale Brick Corporation, Shillington, Pa.



"100,914 face brick daily, 99% No. 1 quality"
reports Homer Bryce, General Manager, Henderson
Clay Products, Henderson, Texas.

Over 30 years of specialized engineering in the design, construction and profitable operation of production facilities for the ceramic industry.

TUNNEL KILNS • DRYERS • PLANT DESIGN

HARROP



Harrop Ceramic Service Co.
35 EAST GAY STREET COLUMBUS 15, OHIO

Practical ceramic engineering, put profitably to work.



has the "know-how" to help solve your specific production problem . . .

Time and time again, leading ceramic producers have turned to Harrop for assistance in solving tough problems in the production of better ware with greater efficiency.

Harrop has responded with technical research . . . careful planning and knowledgeable engineering . . . speedy, exacting construction of dryer and kiln facilities, each specially designed to meet specific requirements. Over 400 major Harrop installations give you assurance of Harrop's "Practical Ceramic Engineering, Put Profitably to Work."

All this can be yours . . . backed by more than a century of ceramic engineering experience represented by Harrop principals . . . all this can provide the practical, profitable answer to your production problems.

WHATEVER YOUR NEEDS . . . a new dryer or kiln, or the modernization of an existing unit . . . a whole new plant, or the expansion and up-dating of your present facilities . . . you can place your confidence in Harrop. A non-obligating consultation is the first step . . . write, wire or phone.

HARROP installations are profitably at work in these plants throughout the world

The many multiple installations are concrete evidence of satisfactory service and performance.

Sanitary Ware

	No. of Operating Units
The A. A. Corp.	1
Abingdon Potteries, Inc.	4
Alamo Pottery, Inc.	4
Clay Products Co., Panama	4
Mansfield Sanitary Pottery, Inc.	4
National Plumbing Pottery Co.	2
Nechustan, Ltd., Israel	1
Peerless Pottery Co.	4
Rockport Sanitary Pottery Co.	2
United Sanitary Corp.	2

Refractories and Specialties

Acme Brick Co.	2
A. C. Spark Plug Div., General Motors Corp.	1
Armstrong Cork Co.	2
Basic Refractories, Inc.	1
Canadian Refractories, Ltd., Canada	1
Ceramica Sao Caetano, S. A., Brazil	4
Consolidated Rand Brick Co., South Africa	1
Emasco Refractories Co.	1
General Refractories Co.	3
Gladding, McBean & Co.	5
Globe Brick Co.	1
A. P. Green Fire Brick Co.	7
Harbison-Walker Refractories Co.	6
Huntly Brick & Fire Clay, Ltd., N. Z.	1
Industrial Ceramic Products, Inc.	2
Keramos, S. A., Mexico	2
Massillon Refractories Co.	1
Mexico Refractories Co.	4
Morganite Brush Co., Inc.	1
Niles Fire Brick Co.	1
North American Refractories Co.	1
Robinson Clay Product Co.	4
S. A. T. I. C. Argentina	1
John G. Stein & Co., Scotland	3
Stockton Fire Brick Co.	1
Utah Fire Clay Co.	1
Valentine Fire Brick Co.	2

Dinner Ware • Semi-Porcelain

Canonsburg Pottery Co.	1
Ceramica Industrial Costarricense, Costa Rica	2
Crooksville China Co.	1
Fabrica de Loza "La Favorita" S.A., Mexico	2
Fabrica "Nueva San Isidro" S.A., Mexico	2
Harker Pottery Co.	1
Edwin M. Knowles China Co.	2
Homer Laughlin China Co.	10
Loza Fina S.A., Mexico	2

	No. of Operating Units
Mount Clemens Pottery Co.	6
Paden City Pottery Co.	1
Royal China, Inc.	1
Salem China Co.	1
Steuenville Pottery Co.	1
Taylor, Smith & Taylor Co.	2
Universal Potteries, Inc.	1

Dinner Ware • Vitrified China

Mayer China Co.	2
D. E. McNicol Pottery Co.	2
Medalta Potteries, Ltd., Canada	2
Pidgeon Vitrified China Co.	3
Shenango Pottery Co.	2
Technical Porcelain & China Ware Co.	2
Treple-Blake China Co.	2
Wellsville China Co.	1

Floor and Wall Tile—

Roofing and Quarry Tile

Aztec Ceramics, Inc.	2
Cambridge Tile & Mfg. Co.	2
Carlyle Tile Co.	1
Ceramica Emperya, Brazil	1
Ceramica Industrial "El Aquila" S.A., Mexico	1
Ceramica San Joao, Brazil	1
Ceramica Santa Catarina, Brazil	1
Ceramica Sao Caetano, S.A., Brazil	3
Clay Products Co., Inc., Panama	3
Flamingo Tile Corporation	1
Industria Ceramica Americana, Brazil	1
Kraftile Co.	1
Mid-State Tile Co., Inc.*	1
National Tile Co.	3
Stylon Corp.	2
Stylon Southern Corp.	4
Union Ceramics, Ltd., South Africa	1
The U. S. Encaustic Tile Co.	1
Wheeling Tile Co.	1

High Temperature Ceramic Specialties

A. C. Spark Plug Div., General Motors Corp.	1
Frenchtown Porcelain Co.	1
Globe-Union, Inc.	22
Grahamstown Potteries, South Africa	1
Marshall Eclipse Div., Bendix Aviation Corp.	1
McDaniel Refractory Porcelain Co.	1
Page-Madden Co., Inc.	1
Pemco Corp.	1
R. C. A. Victor Div.	1
Solar Manufacturing Corp.	1
Scintilla Magneto Div., Bendix Aviation Corp.	3
Stupakoff Ceramic & Mfg. Co.	5
Western Electric Co.	1

Electrical Porcelain

Ceramic Specialties Co.	1
Fabrica de Loza "El Anfora" S.A., Mexico	3
Frenchtown Porcelain Co.	1
Illinois Electric Porcelain Co.	2
Knox Porcelain Corp.	1
Lapp Insulator Co., Inc.	2
Locke Insulator Corp.	1
New Jersey Porcelain Co.	1
Nippon Gaiishi Kaisha, Ltd., Japan	2
The Ohio Insulator Co.	1
Porcelain Insulator Corp.	1
Porcelain Products, Inc.	1
Square D Co.	1
R. Thomas & Sons Co.	2
Westinghouse Electric Corp.	5

Stoneware, Artware, etc.

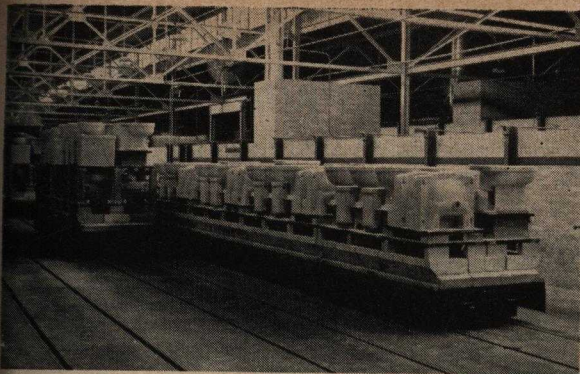
Brush Pottery Co.	1
Cantor Decorating Co.	1
Ceramica Valenciana S. de R. L. Mexico	1
Ceramo Co.	1
Denna Artware Co.	2
Frankoma Potteries, Inc.	1
GalaMo Arts, Inc.	1
Garden City Pottery Co.	1
Gibraltar Mfg. Co.	1
Haeger Potteries, Inc.	1
Hyalyn Pottery, Inc.	1
Nelson McCoy Pottery Co.	1
New England Ceramics	1
Polynesian Arts	3
Red Wing Potteries, Inc.	2
Regal China Co.	1
Royal China & Novelty Co.	2
Sippi Products, Inc.	2
Texans, Inc.	1
W. I. Tyner Pottery Co.	1
Zanesville Stoneware Co.	1
Zapun Ceramics	1

Face Brick, Structural Tile, Sewer Pipe

Acme Brick Co.*	7
Alexandra Brick & Tile Co.*	1
Allday Clay Products Co.*	1
Alton Brick Co.	1
Baton Rouge Brick & Tile Co.*	2
Bickerstaff Brick Co.	1
Binghamton Brick Co.	1
Bordon Brick & Tile Co.	1
Brick & Potteries Co., Ltd., South Africa*	7
Brookhaven Pressed Brick Mfg. Co.	2
W. G. Bush & Co.*	3
Canada Brick, Ltd.	2
Ceramica Assad S.A., Brazil	4
Champion Brick Co.	1
Champlain Brick Co.	1
Chatham Brick & Tile Co.	2

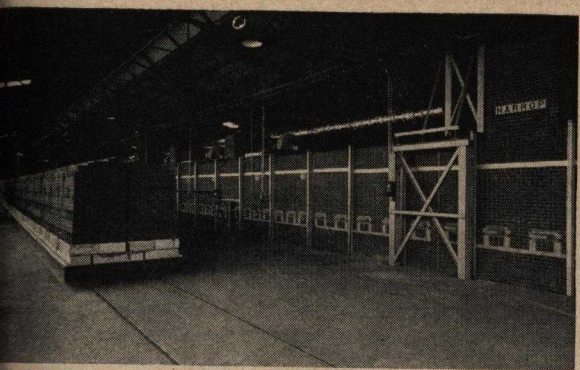
	No. of Operating Units
Cia. Ceramica Vale do Paraiba, Brazil*	1
Cloud Ceramics	1
Columbia Brick & Tile Co.	1
Daniels Brick & Tile Co.	1
Delaware Clay Co.	1
Delta Brick & Tile Co.*	2
John A. Denie's Sons Co.*	2
Denning's Point Brick Works, Inc.	1
Frank J. Derrick Brick Co.	1
Dixie Brick Co.	1
Elgin Butler Brick Co.	1
Elgin Standard Brick Mfg. Co.	1
Eureka Brick & Tile Co.*	1
Fairfield Brick & Sand Co., Ltd., New Zealand	1
Fenati Brick Co.	1
Fraser Brick & Tile Co.*	1
Galena Shale Tile & Brick Co.	1
General Shale Products Corp.*	1
Gladding, McBean & Co.	1
Glen-Gery Shale Brick Corp.	1
Hammond Baton Rouge Brick Co.*	1
Henderson Clay Products*	1
Holly Springs Brick & Tile Co.*	1
Hope Brick Works*	1
Houston Brick & Tile Co.*	1
Hydraulic Press Brick Co.	1
Ideal Brick Co.*	1
Kasten Bros. Brick Co.	1
M. Lanz Brick & Tile Co.*	1
Locher Brick Co., Inc.*	1
Lowell Brick & Tile Co.*	1
Major Brick Co.*	1
Marshall Brick Co.	1
Martin Brick Co.	1
Medicine Hat Brick & Tile Co.	1
Nassau Brick Co.	1
Natco Corp.	2
Oberly Brick Co.	1
Ohio Clay Co.	1
Pine Hill Brick & Pipe Co.	1
Purinton Brick & Tile Co.*	1
Quakertown Brick & Tile Co., Inc.	1
Redford Brick Co.	1
Rhodesian Brick & Potteries Co., Ltd., Southern Rhodesia*	1
Richland Shale Brick Co.*	1
Roanoke-Webster Brick Co.*	1
Sanford Brick & Tile Co.*	1
Southern Brick Co.	1
South Side Brick Works, Inc.	1
Stanley Shale Products, Inc.*	2
Staso Milling Co.	2
Statesville Brick Co.*	2
Toronto Brick Co., Canada	3
Tri-State Brick & Tile Mfg. Co.*	3
United Brick & Tile Co.	4
Utah Fire Clay Co.	1
Western Clay Co.	1
Western Clay Mfg. Co.	1
Yadkin Brick Yards*	2

*Denotes special Harrop-developed DRYER-KILN installation. See page 4.

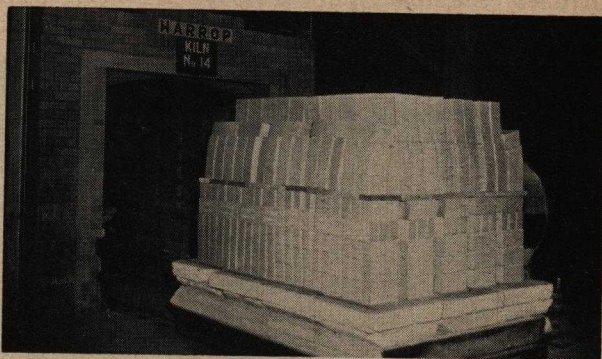


SANITARY WARE Line of cars of fired ware from four HARROP kilns.

**HARROP-engineered
dryers and kilns
increase output...
improve quality...
lower costs...
in the production of
many ceramic products**



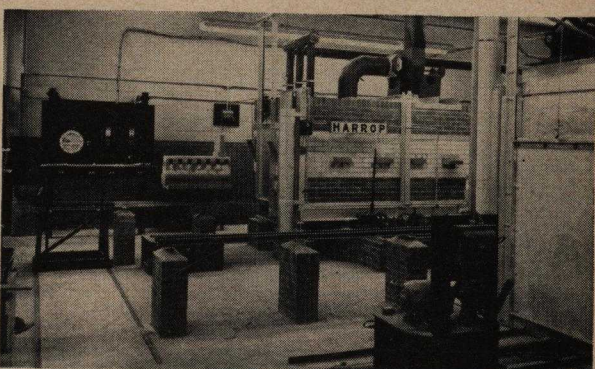
FACE BRICK 50,000 face brick per day are produced in this HARROP dryer-kiln unit... view shows charging end and looking toward pre-heat zone.



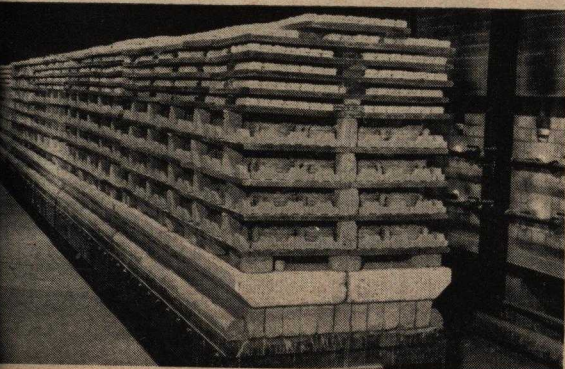
REFRACTORIES View of car loaded with refractories, at discharge end of a HARROP kiln.



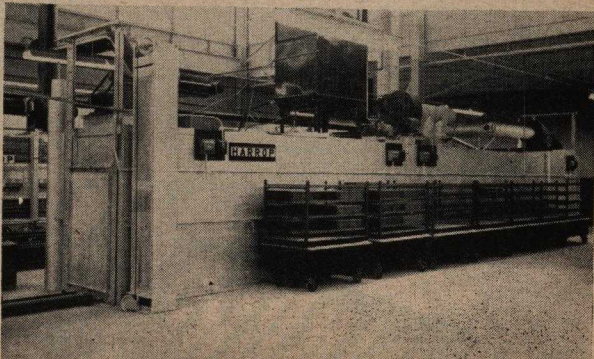
DINNERWARE Placing once-fired dinnerware in HARROP circular kiln. No saggars are used for this firing.



HIGH TEMPERATURE CERAMIC SPECIALTIES Charging end and control panel of HARROP kiln for the fixing of ceramic specialties up to 3000° F.



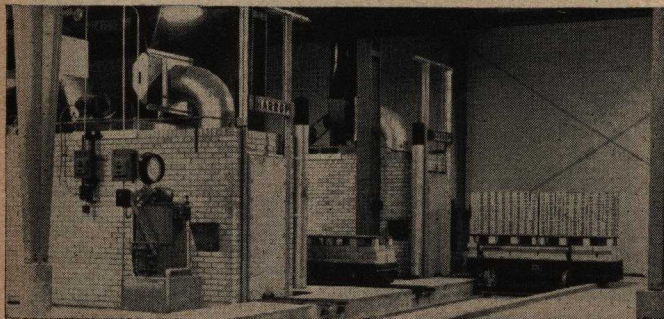
ELECTRICAL PORCELAIN Note how car loading space is conserved. This HARROP kiln is equipped to fire either natural gas or vaporized oil.



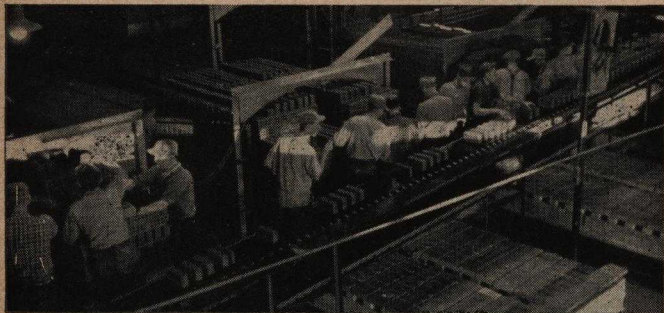
HARROP high temperature continuous oven installed with above kiln.

HARROP Dryer-Kilns reduce handling time and ware loss... increase quality

In the Harrop dryer-kiln combination, drying and firing is a continuous operation. The controlled circulation of clean waste heat in the dryer portion results in worthwhile fuel economy. A special burner arrangement and controlled recirculation in the oxidation zone of the kiln improves ware quality and cuts losses.



Pictured are 2 of the 4 HARROP car tunnel kilns (with dryer combinations) at Styron Southern Corp., Florence, Ala. Product is highest quality, once-fired, glazed wall tile. Production in each kiln is over 9000 sq. ft. per 24-hour day. Total Cycle of 15 hours for drying and firing. Firing Temperature is Orton cone 3. Heat Differential is less than $\frac{1}{2}$ cone throughout setting.



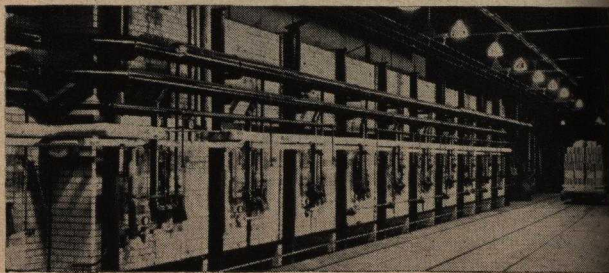
This HARROP installation permits the loading of green brick on kiln cars directly from the off-bearing belt. HARROP dryer-kiln combination then continuously handles the cars.



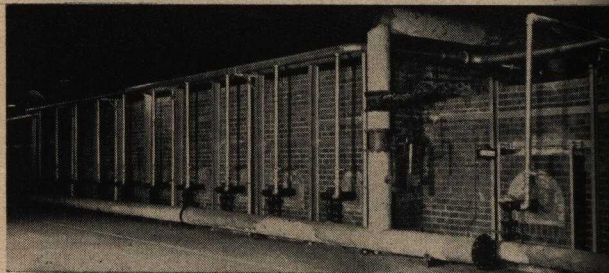
Cars of brick from a HARROP dryer-kiln are quickly and easily unloaded with a fork-lift truck for shipment.

CHOICE OF FUELS for your Harrop kiln

The most economical local fuel supply is utilized in each Harrop kiln installation... coal, producer gas, electricity, oil, gas, combination oil and gas.



OIL and GAS team up to assure steady operation at Harbison-Walker Refractories Co., Portsmouth, Ohio. Dual fuel systems assure steady operation during seasons when one fuel supply might be interrupted.



PRODUCER GAS is used successfully for the firing of highest quality face brick at Glen-Gery Shale Brick Co. plants.

HARROP Electric Furnaces for Research...Testing...Small Scale Production

Harrop Electric Furnaces are designed to meet a wide range of high temperature heating requirements efficiently and economically.

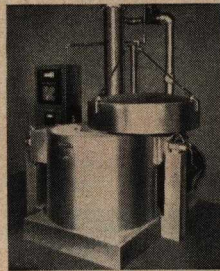
Standard models have setting space from 7" x 9" x 36" to 36" x 36" x 40". Optional instrumentation to accomplish simple temperature control, repetitive heating to any preselected temperature with or without adjustable holding time, or with complete program control.

Silicon carbide heating elements assure uniform, clean, safe heating to 2800°F. with intermittent heating to 3000°F. Blower accelerates cooling cycle for faster controlled operation.

HARROP Model NMR-7, setting space: 7"x9"x9".



HARROP Model GFHT-18, gas-fired; setting space: 18" diam. by 20" high.



Tangentially gas-fired cylindrical furnaces greatly simplify refractory problem—give firm uniform support to the refractories, allow them to be worked near their theoretical limits, simplify maintenance and replacement. Furnaces of this type are equipped with an efficient type recuperator for preheating combustion air for firing continuously up to 3300°F., and in special design up to 3450°F., using fuel gas with a rating of 1,000 BTU or better. Available pedestal diameters of 8", 12", 18", 36".

SPECIAL FURNACES with setting space of unusual shape or size, variation in door opening, temperature range or any other specific requirement will be designed and built by Harrop. Depend on Harrop's years of experience and engineering know-how to solve your furnace problems. For a non-obligating recommendation from our technical advisers send information on materials, temperature range, heat control and firing objectives to Harrop Electric Furnace Division, Dept. A, Harrop Ceramic Service Co., 3470 E. Fifth Ave., Columbus 19, Ohio.



Harrop Ceramic Service Co.
35 EAST GAY STREET COLUMBUS 15, OHIO

British Associate: British Ceramic Service Co., Ltd.,
Bricco House, Stoke-on-Trent, England

THE HAUSER-STANDER TANK COMPANY

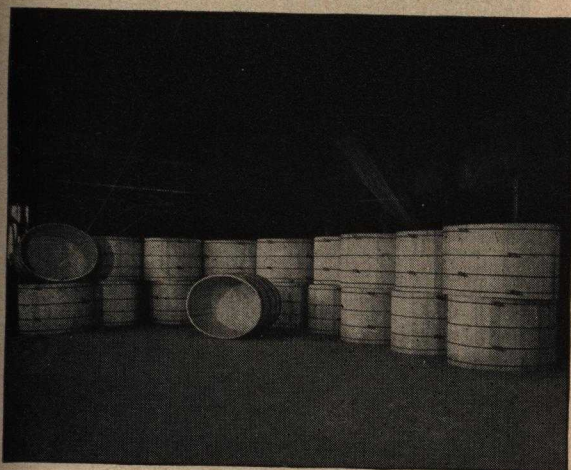
NINETIETH ANNIVERSARY

WOOD TANKS FOR EVERY PURPOSE

4822 Spring Grove Ave. Cincinnati 32, Ohio

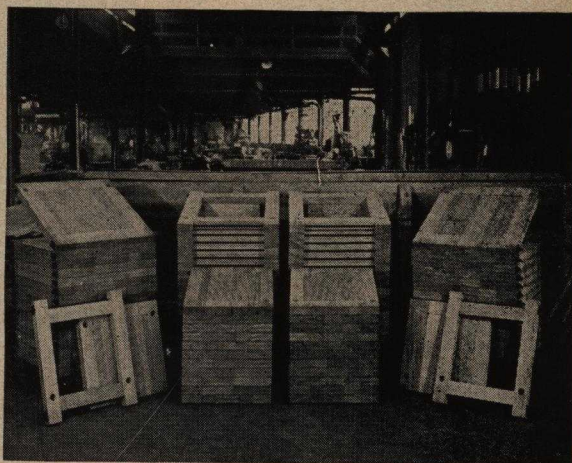
Scope

Our range of manufacture includes wood containers of every shape and size—round, oval, half-round, rectangular, special shapes—from small process tubs to units holding hundreds of thousands of gallons.



Small oval tanks for batch mixing. Sturdy portable units made from two inch lumber.

WE
WIN
WITH
QUALITY



Filter Plates—Fine Quality Wood Filter Press Plates and Frames, complete with Tie Rods of any metal.

Engineering

All products designed by us are soundly engineered. Customers' specifications and drawings are studied carefully, and suggestions offered, based on our varied and lengthy specialized experience. Design Drawings of Tanks, supports, etc. furnished if wanted.

Facilities

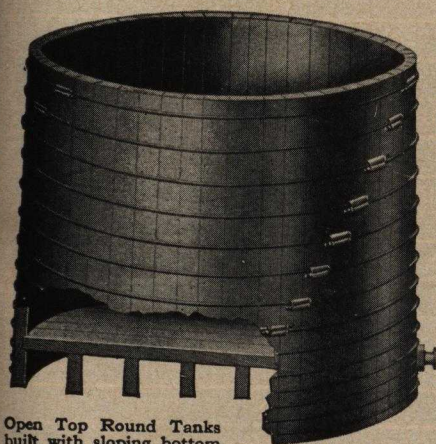
Our plant layout makes possible the fabricating of many thousands of board feet of lumber daily into a varied assortment of plain and intricate tank parts. Straight line production and adequate shipping facilities make possible prompt shipments.

Products

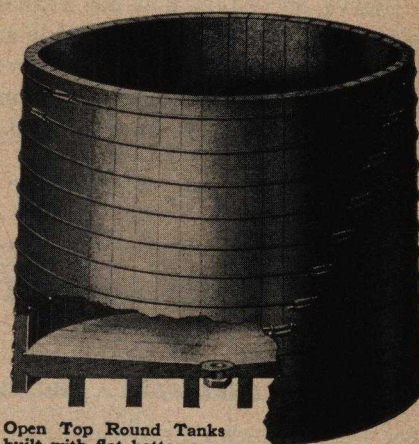
Wood Tanks, Storage or Process
Filter Press Plates and Frames
Miscellaneous Construction in wood,
such as Agitator Stirrers, Wood
Turnings and Special Shapes
Lead Linings for Wood Tanks
Polyvinyl Linings
Lead Lined Steel Tanks
Wood Pipe—Plank and Timbers

Specifications

Highest Quality Materials are used in all types of construction. Expert workmanship is employed at all times. Products built to our standards or to customers' drawings include wood tanks of any size in common or special shapes—plain or lined with lead or plastics.



Open Top Round Tanks built with sloping bottom with proper supports.



Open Top Round Tanks built with flat bottoms or special concave bottom

The Book of Tanks is available for the asking. It should aid in acquainting all on the general subject of Wood Tanks, and give specific information in numerous instances.

HEAVY MINERALS CO.

4000 NORTH HAWTHORNE STREET • CHATTANOOGA, TENNESSEE



A Domestic Rare Earth Operation From Mine to Consumer

HEAVY MINERALS CO. is the only rare earth producer in the United States which owns and operates its own mines.

Rare earth source materials—monazite and xenotime—are mined by HEAVY MINERALS and processed at HMC's modern Chattanooga plant into mixed and individual rare earth chemicals and thorium.

HEAVY MINERALS now has available rare earth oxide and salts, cerium-free rare earth oxide and salts, and didymium (classical) oxide and salts, as well as the individual rare earth chemicals listed at right. Perhaps one of these materials will fit the application you have in mind.

Send for free informative booklet



HEAVY MINERALS CO.

RARE EARTH CHEMICALS • THORIUM • HEAVY MINERALS

4000 NORTH HAWTHORNE STREET, CHATTANOOGA, TENN.
NEW YORK SALES OFFICE: 261 MADISON AVENUE, N. Y. 16, N. Y.

PRODUCT	Formula	Atomic No.	
Scandium	Sc	21	
Scandium Oxide	Sc ₂ O ₃		
Yttrium	Y	39	
Yttrium Oxide	Y ₂ O ₃		
Lanthanum	La	57	
Lanthanum Oxide	La ₂ O ₃		
Cerium	Ce	58	
Cerium Oxide	CeO ₂		
Praseodymium	Pr	59	
Praseodymium Oxide	Pr ₆ O ₁₁		
Neodymium	Nd	60	
Neodymium Oxide	Nd ₂ O ₃		
Samarium	Sm	62	
Samarium Oxide	Sm ₂ O ₃		
Europium	Eu	63	
Europium Oxide	Eu ₂ O ₃		
Gadolinium	Gd	64	
Gadolinium Oxide	Gd ₂ O ₃		
Terbium	Tb	65	
Terbium Oxide	Tb ₄ O ₇		
Dysprosium	Dy	66	
Dysprosium Oxide	Dy ₂ O ₃		
Holmium	Ho	67	
Holmium Oxide	Ho ₂ O ₃		
Erbium	Er	68	
Erbium Oxide	Er ₂ O ₃		
Thulium	Tm	69	
Thulium Oxide	Tm ₂ O ₃		
Ytterbium	Yb	70	
Ytterbium Oxide	Yb ₂ O ₃		
Lutetium	Lu	71	
Lutetium Oxide	Lu ₂ O ₃		
Thorium	Th	90	
Thorium Oxide	ThO ₂		

NOTES: (1) Index of Refraction — Cerium 2.33-2.35, Thorium 2.20 (lg), (2) Dielectric Constant — Cerium 7.0, Thorium 10.6, (3) Linear Elasticity Modulus — Lanthanum 3.820 Kg/mm²

PROPERTIES OF RARE EARTHS AND THORIUM

Formula Wt.	Density	M. P. °C	B. P. °C	Oxide States	Ionic Radius Å°	Normal Color	Δ H. VAP. (Kcal/mole)	Δ H. FUS. (Kcal/mole)	Crystal Stru.	Trans. Temp. °C	Brinell Hardness	Compress- ibility (Cm ² / Kg x 10 ⁶)	Neutron Absorption Cross-Sect. (Barns)	Electric Resist. (Microhm—cm. 25°C)
44.96	3.016	1550-1600	2477	III			73	3.8	h. c. p.				22	
138.06	3.86				1.51	White								
88.92	4.472	1552	3027	III			80	4.1	h. c. p.			2.96	1.38	
225.84	4.8-5.0	2410			1.06	White			Cubic					
138.92	6.162	920	4242	III			81	2.4	Hex f. c. c.	300-350 868	37	4.06	8.9	56.8
325.8	6.51	2315			1.061	White			Hex					
140.13	6.768	804	2927	III, IV			79	2.2	f. c. c.	754	28	3.87	.70	75.3
172.1	7.3	2600			1.034	White			Cubic					
140.92	6.769	935	3017	III, (IV)			79	2.4	Hex	798	25	3.67	11.2	68.0
1021.5					1.013	Black			Cubic					
144.27	7.007	1024	3177	III			69	2.6	Hex	868		3.19	46	64.3
336.5	7.24				0.995	Lt. Blue			Hex					
150.35	7.540	1052	1627	(II), III			46	2.6	Rhom	917		3.71	5500	
348.7	7.43	2300			0.964	Off-White			Cubic					
152.0	5.168	<826	1427	(II), III			40	2.5	b. c. c.				4600	
352.0	7.42	2050			0.950	White			Cubic					
157.26	7.868	1350	2727	III			72	3.7	h. c. p.			2.58	46000	
362.5	7.407	2330			0.938	Off-White			Cubic					
158.93	8.253	1360	2527	III, (IV)			70	3.9	h. c. p.	1310			44	
747.7					0.923	Dk. Brown			Cubic					
162.51	8.556	>1400	2327	III			67	4.1	h. c. p.			2.74	1100	
373.0	7.81	2340			0.908	White			Cubic					
164.94	8.799	1500	2327	III			67	4.1	h. c. p.			2.66	64	
377.9					0.894	Lt. Yellow			Cubic					
167.27	9.058	1500-1550	2627	III			70	4.1	h. c. p.			2.63	166	
382.5	8.640				0.881	Rose-red			Cubic					
168.94	9.318	1550-1600	2127	III			56	4.4	h. c. p.			2.72	118	
385.9	8.6				0.869	Greenish White			Cubic					
173.04	6.959	824	1527	(II), III			40	2.2	f. c. c.	798		8.00	36	
394.1	9.2				0.858	White			Cubic					
174.99	9.849	1650-1750	1927	III			59	4.6	h. c. p.			2.32	108	
398.0					0.848	White			Cubic					
232.05	11.2	1845	4500	IV					f. c. c.	225	75-80 VPN		7	18.6(20°C)
264.12	10.03	3050	4400		1.80-1.82	White			Cubic					

REFERENCES: (1) C. J. Gorter, Progress in Low Temp. Physics, North Holland Pub. Co., Amsterdam, 2, 370-371 (1957), (2) Donald J. Hughes and John A. Harvey, Neutron Cross Sections, Brookhaven National Lab. (1955), (3) F. H. Spedding, A. H. Daane and K. W. Herrmann, J. Metals, 9, 895 (1957). For general bibliography see Reference No. 1.

The above data have been compiled from the literature and are believed to be the most accurate available. Heavy Minerals Co. can assume no responsibility, however, for any errors in the data or the compilation.

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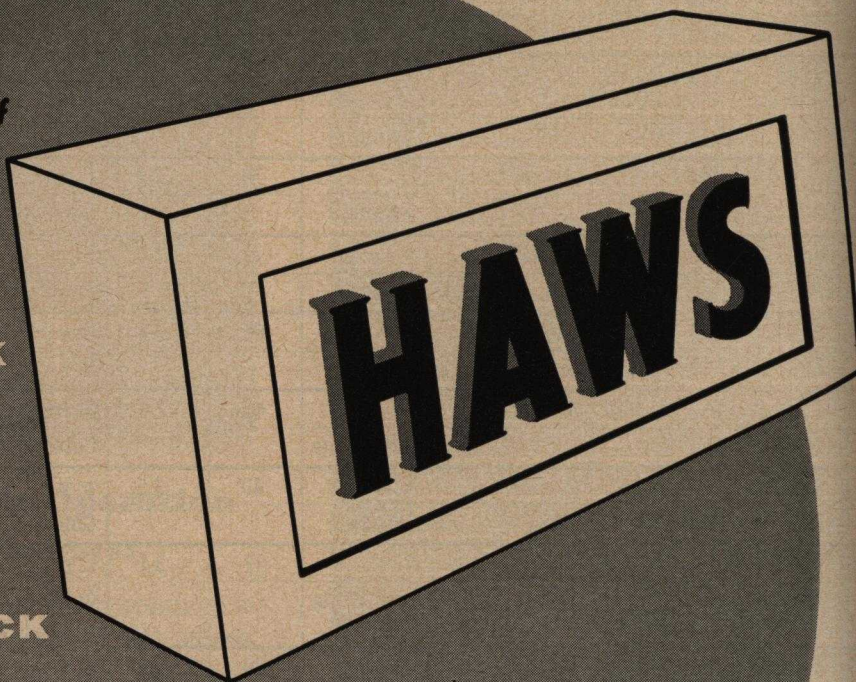
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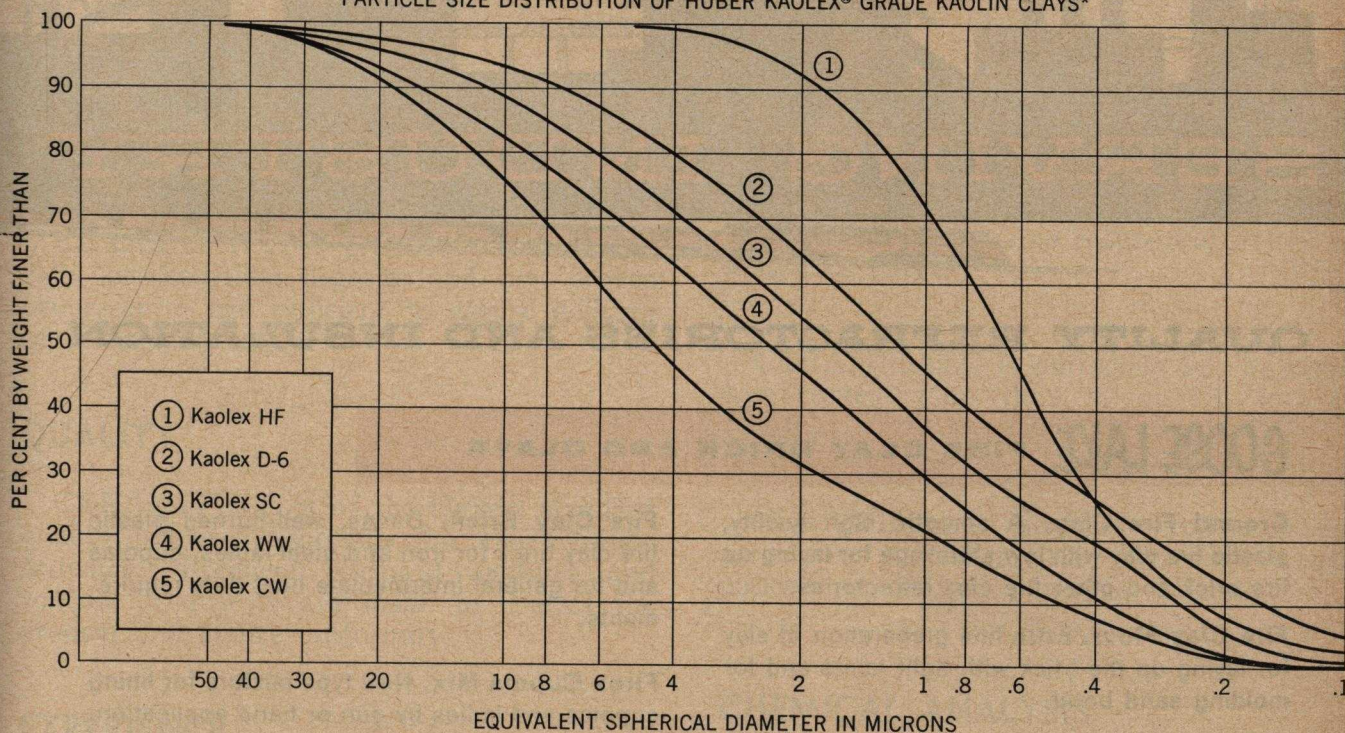


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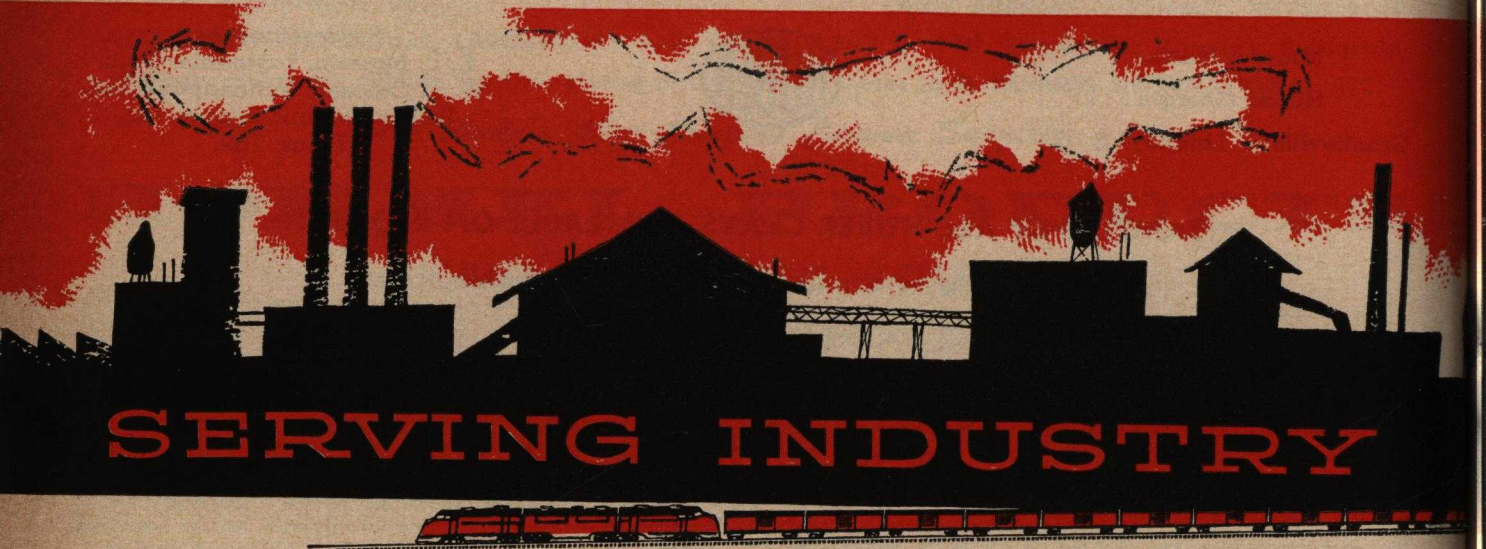


Properties	HF	D-6	SC	WW	CW
G. E. Brightness, %	86-87	77-81	76-78	82-84	80-82
% Moisture	2-4	1-2	1-2	2-4	2-4
Screen Residue (max.)					
200 mesh, %	.01	.05	.05	.03	.03
325 mesh, %	TR	.60	.50	.30	.30
Fired Color	White	White	White	White	White
P.C.E.	35	34-35	34-35	34-35	34-35
Uses					
Casting			✓	✓	✓
Extrusion		✓		✓	✓
Pressing	✓	✓			
Jiggering	✓	✓			

*Kaolex Clays are shipped in bulk (lump or pulverized form) or in 50-pound multiwall paper bags. Write for additional information

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Ground Fire Clay. A smooth, high quality, plastic fire clay with low shrinkage for laying up fire brick and other fire clay refractories.

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Coating. An insulating cement for application as a plastic on furnace brick-work exposed to temperatures up to 2000°F.

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CERAMITALC is an economical source of Magnesia (MgO).

CERAMITALC is uniformly low in moisture content (less than $\frac{1}{2}$ of 1% loss at 212°F).

CERAMITALC increases production by permitting a shorter firing cycle and makes possible production of brighter colors.

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Silica (SiO ₂)	58.30%
Magnesia (MgO)	28.80%
Lime (CaO)	5.90%
Iron Oxide (Fe ₂ O ₃)	.30%
Alumina (Al ₂ O ₃)	.85%
Carbon Dioxide (CO ₂)	1.50%
Ignition Loss	4.30%
Moisture (loss at 212°F)	less than $\frac{1}{2}$ of 1%

We are proud to state that most of the large ceramic manufacturers are our customers and have been using our CERAMITALC for many years to their entire satisfaction.

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By an ingenious method, the press can be arranged to manufacture cored brick or large hollow block to compete with concrete block.

Capacity—Fire Brick Squares—2 Cavity Mold Box, 1000 per Hour—4 cavity, 2000 per Hour—5 cavity, 2500 per Hour with average material.

This press can be adapted to make cored brick.

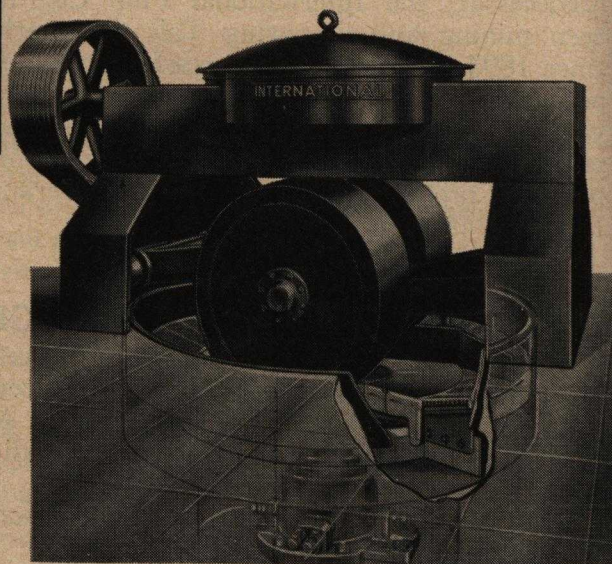
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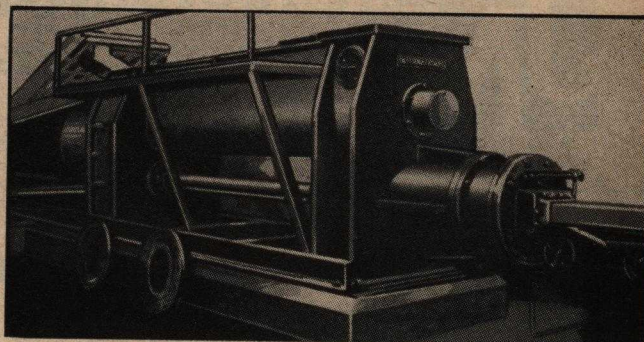


EQUIPMENT FOR THE CERAMIC & ELECTRONIC INDUSTRIES—WALL TILE—SANITARY WARE—ELECTRIC PORCELAIN—CHINAWARE AND ELECTRONICS.



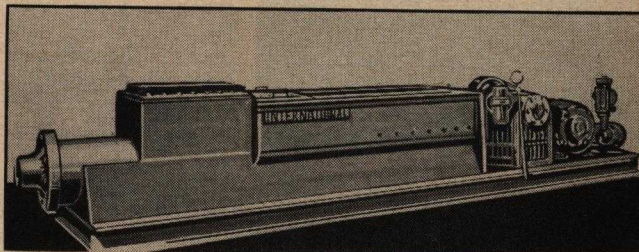
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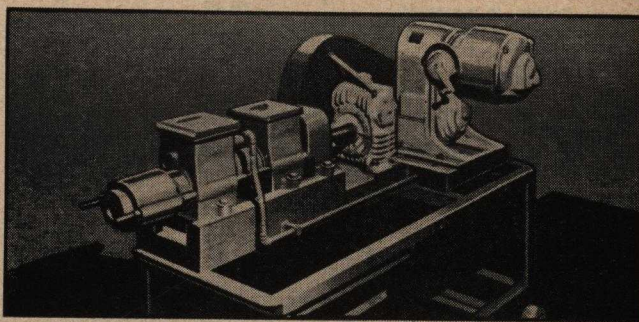
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Vac-Aire Pug Mills have become the standard for white-ware plants throughout the world—hundreds in operation . . . Extrudes a bar of clay from varying water content filter press cakes that is absolutely homogeneous . . . Slice a sheet from the bar of clay and note the same water content from center to outside rim . . . Long Pug Mill and long Vacuum Chamber is secret of Vac-Aire efficiency—Less Power—less maintenance—Auger sizes 3" to 15"—Particularly adapted to pugging and extrusion of chinaware and electric porcelain.



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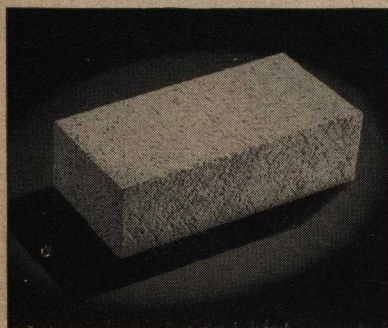
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J-M INSULATING FIRE BRICK



Johns-Manville Insulating Fire Brick are made in six types for use as refractory lining or as back-up insulation behind other refractory protection. Each type has the correct balance of thermal and physical properties for its recommended service. All six types offer light weight,

Molded from specially selected, high quality kaolin clays plus alumina, it raises to a new high point the temperature for which such a product can safely be recommended. Sizes, types and properties of J-M Insulating Fire Brick are given in the table below.

Mortars for Laying J-M Insulating Fire Brick

Type brick	Mortar	Approx. lb. needed per 1000 brick
JM-3000	J-M Special Bonding Mortar (air-set)	400
JM-28 JM-26 JM-23 JM-20 JM-1620	J-M Blakite® Cement (air-set)	200-400*
	J-M I.F.B. Mortar (heat-set)	200

*Amount depends upon thickness of joint and porosity of brick

low conductivity and high structural strength. JM-3000 Insulating Fire Brick provides long-life insulation at a full 3000F, in back-up or direct exposure service.

Properties (Average Values)	Types of J-M Insulating Fire Brick					
	JM-3000	JM-28	JM-26	JM-23	JM-20	JM-1620
Standard Sizes	Accurately sized in all standard 9 in. shapes of the 2½ series, as well as special shapes.					
Temperature Limit	†3000 F	†2800 F	†2600 F	†2300 F	†2000F	‡2000 F †1600 F
Approx. Density, lb per cu ft	63-67	58	51	44	33	31
Transverse strength, psi	200	175	140	130	100	80
Cold crushing strength, psi	400	300	210	200	150	120
Linear shrinkage, percent	*0.8 at 3000F	1.0 at 2800F	1.0 at 2600F	0.3 at 2300F	0.0 at 2000F	0.0 at 2000F
Reversible thermal expansion, percent	0.5-0.6 at 2000F	0.5-0.6 at 2000F	0.5-0.6 at 2000F	0.5-0.6 at 2000F	0.5-0.6 at 2000F	0.5-0.6 at 2000F
Conductivity (Btu in. per sq ft per F per hr at following mean temperatures)						
500F	3.10	2.55	2.07	1.51	0.91	0.77
1000F	3.20	2.80	2.45	1.91	1.10	1.02
1500F	3.35	3.06	2.83	2.31	1.29	1.27
2000F	3.50	3.32	3.22	2.70	....	....

*24-hr Simulative Service Panel Test; all others 24-hr soaking period.

†Back-up or Exposed.

‡Back-up only.

SIL-O-CEL® INSULATING BRICK

Made from diatomaceous silica, Sil-O-Cel Insulating Brick are particularly useful where high load-bearing characteristics are required. They are furnished in three types for use as back-up insulation behind refractory fire brick linings or behind insulating fire brick linings. Sil-O-Cel 16L brick may be used for exposed as well as back-up service.

Mortars Required

Type brick	Mortar	Approx. lb. needed per 1000 brick
Sil-O-Cel Super	Super Brick Mortar	80
Sil-O-Cel C-22 Sil-O-Cel 16L	Sil-O-Cel Mortar	80
Sil-O-Cel 16L, exposed	J-M Blakite Cement	200-400

Size and Properties of Sil-O-Cel Insulating Brick

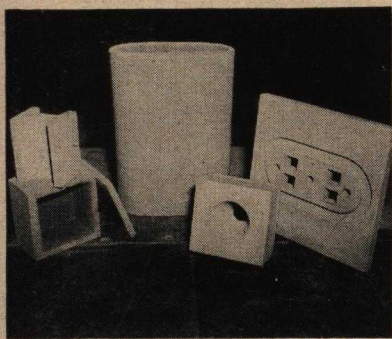
Properties (Average Values)	TYPES		
	Super 2500 F (back-up only)	C-22 2000 F (back-up only)	16L 1600F (back-up or exposed)
Standard sizes	All standard 9" shapes of the 2½" and 3" series, as well as special shapes		
Approx. Density, lb per cu ft	40	38	33-35
Transverse strength, psi	90	115	60
Cold crushing strength, psi	300	700	350
Linear shrinkage, percent	2.0 at 2500F	0.8 at 2000F	0.7 at 1600F
Reversible thermal expansion, percent	1.3 at 2000F	0.7 at 2000F	Less than 0.1 at 1600F
Conductivity (Btu in. per sq ft per F per hr at following mean temperatures)			
500F	1.70	1.67	0.92
1000F	1.95	1.88	1.07
1500F	2.19	2.08	1.22
2000F	2.45	....	....

Johns-Manville REFRACTORY Products

J-M HYDRAULIC-SETTING REFRACTORIES

For Temperatures Through 3000F

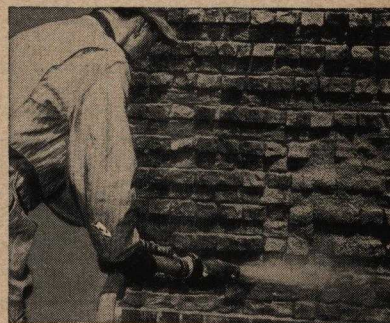
FIRECRETE® CASTABLE REFRACTORIES



There is a J-M Firecrete for practically every castable requirement at temperatures through 3000 F. Each is economical and efficient in its recommended service range. All types harden rapidly, have no drying shrinkage, are highly resistant to spalling, have negligible firing shrinkage in use at recom-

mended temperatures, and are easy to mix, cast and install. A small stock of Firecrete eliminates the expense and inconvenience of carrying a wide assortment of fired shapes. And costly delays in operation can be avoided; Firecrete permits casting and use of any desired shape within 24 hours. The choice of Firecrete depends on particular service requirements involved . . . data is given in table below.

BLAZECRETE® FOR TROWELING AND GUNNING



Four types of dry, monolithic, hydraulic-setting refractories have been developed by Johns-Manville especially for gunning and slap-troweling applications. Especially adaptable for gun application in building new refractory linings and repairing old ones, they adhere readily with a minimum of loss when "shot" in place. Mixed with water at gun nozzle, Blazecrete is pneumatically projected with great force, resulting in a denser, more homogeneous lining. The three Blazecretes are equally effective for heavy patching by troweling, especially where brickwork has eroded deeply . . . eliminate laborious ramming or tamping. Data on various types is given in table below.

DATA ON FIRECRETE AND BLAZECRETE

Type	Name	Character or base	Highest working temperature, F	Approx. pounds needed per cu ft	Packaging
Castables	3X Firecrete	High alumina	3000	130	100-lb bags
	H.T. Firecrete		2800	110	
	Std. Firecrete		2400	75	
	L.W. Firecrete	Al. silicate	2000	58	50-lb bags
	No. 20 Firecrete		2600	75	100-lb bags
	CA Insulating Firecrete		3000	175	
	C-31-M Refractory Cement	Chrome			
Gunning and Slap-troweling cements	3X Blazecrete	High alumina	3000	gunning, 155; slap-troweling, 130	100-lb bags
	Std. Blazecrete	Al. silicate	2400	gunning, 120; slap-troweling, 110-115	50-lb bags
	L.W. Blazecrete		2000	gunning, 71-81; slap-troweling, 62-67	
	C-2 Refractory Cement		2300	slap-troweling, 120	100-lb bags

Johns-Manville makes a refractory product to meet practically every service condition — ready-mixed, air-setting cements and mortars; dry, heat-setting and air-setting cements and mortars; plastics; and ramming mixtures. In addition to these refractory products, Johns-Manville also manufactures insulations for temperatures from -300F to

3000F above; a complete line of packings and gaskets; brake linings and clutch facings; roofing and siding; Pallite® pallets for drying ceramic ware, and many other products for use in the ceramic industry. For complete information, write Johns-Manville.



KENTUCKY-TENNESSEE CLAY CO.

Alliance, Ohio • Mayfield, Kentucky • Paris, Tennessee

KENTUCKY BALL CLAYS

GRADE CLAY	New Old Mine No. 4	New Kentucky Special	K-T Ivory	No. 5095	Jackson Ball	No. 5 Ball
Crude Appearance	Medium Gray	Dark Brown to Black	Brown	Medium Gray	Medium & Dark Gray	Dark & Light Gray
% Residue 120 Mesh	Trace	.90%	Trace	Trace	.65	.10
Character of Residue	Lignitish	Lignitish	Siliceous	Siliceous	Lignitish	Lignitish
% Water of Plasticity	41.8	51.3	40.0	39.2	40.3	38.2
% Linear Dry Shrinkage	5.3	5.5	5.5	5.1	6.2	4.5
Total Shrinkage Cone 5-6	13.3	13.9	9.3	13.0	14.2	15.0
Total Shrinkage Cone 12	15.8	17.5	14.0	15.0	17.6	15.5
% Absorption Cone 5-6	10.5	13.7	17.2	11.3	9.8	1.5
% Absorption Cone 12	2.2	2.39	6.4	4.31	1.8	.00
Fired Color	Light Gray White	Light Cream White	Ivory	White	Gray White	Gray White
Overfiring Point	—ALL ABOVE CONE 15—					
P.C.E. Value	32	32	31	31-32	32½	32-32½
Av. Bonding Modulus	445	603	320	314	448	329
Chemical Analysis:						
Silicon Dioxide	51.72	49.64	57.93	53.98	54.06	51.79
Aluminum Oxide	31.98	29.33	26.43	30.93	30.12	31.31
Titanium Dioxide	1.52	1.48	2.37	1.50	1.60	1.41
Iron Oxide	.869	.95	.69	.738	.864	1.01
Calcium Oxide	.21	.29	.19	.14	.36	.26
Magnesium Oxide	.19	.25	.40	.20	.34	.20
Potassium Oxide	.89	1.00	.08	.72	.49	1.44
Sodium Oxide	.38	.25	.37	.45	.39	.87
Ignition Loss	12.29	16.81	11.47	11.40	11.84	11.70
Outstanding Properties	Medium grain size, strong, clean firing, good color.	Medium grain size, very strong dark clay, excellent plasticity.	Coarse grained fast casting, medium strength, very good draining properties.	Medium strength, clean white firing, fast oxidizing.	Fine grained, strong, good color, all purpose.	Medium grained excellent casting clay. Long deflocculation range. Excellent drainage. High PCE.
Recommended Use	All type products, cast, pressed, jigged, extruded, including refractories, Steatite and special porcelain.	All type products, cast, pressed, jigged, extruded.	Cast, pressed, jigged products.	Cast, pressed, jigged, extruded products.	All type products, cast, pressed, extruded, jigged products.	All cast products including refractories. Also jigged, pressed and extruded products with finer grained clays.

SAGGER, WAD AND

GRADE CLAY	Tenn. XX	Ky. No. 4 Plastic Fire	Ky. No. 5 Bond	Ky. No. 6 Plastic Fire
Crude Appearance	White & Gray	Light Brown	Gray	Gray
% Residue 120 Mesh	.08	Trace	Trace	Trace
Character of Residue	Siliceous	Siliceous	Siliceous	Siliceous
% Water of Plasticity	34.1	38.7	36.20	26.2
% Linear Dry Shrinkage	4.1	5.4	5.20	4.6
Total Shrinkage Cone 5-6	12.3	10.2	9.3	9.3
Total Shrinkage Cone 12	12.9	13.2	13.1	10.3
% Absorption Cone 5-6	8.4	17.6	13.4	10.9
% Absorption Cone 12	3.2	8.6	5.3	8.7
Fired Color	White	Cream	White	Light Buff
Overfiring Point	—ALL ABOVE CONE 15—			
P.C.E. Value	32	31	32	30
Av. Bonding Modulus	171	335	285	244
Chemical Analysis:				
Silicon Dioxide	59.40	58.09	56.68	64.19
Aluminum Oxide	27.20	26.24	27.99	23.39
Titanium Dioxide	1.60	2.10	1.96	2.16
Iron Oxide	.72	.98	.74	.85
Calcium Oxide	.60	.23	.22	.32
Magnesium Oxide	.22	.35	.12	.30
Potassium Oxide	.68	.40	1.18	.43
Sodium Oxide	.36	.32	.50	.40
Ignition Loss	9.39	11.72	10.51	8.02
Outstanding Properties	Excellent plasticity, low shrinkage, good heat shock properties.	Strong plastic fire clay. Excellent casting, pressing and extruding properties.	Excellent bond, low shrinkage, good PCE. Excellent casting, pressing and extruding properties.	High silica, low shrinkage. Excellent load bearing properties at high temperatures.
Recommended Use	All sagger and refractory products.	All sagger and refractory products. Refractory cements.	Refractory cements, grinding wheel bonds, all sagger and refractory products.	Refractory cements, all sagger and refractory products.

Other grades for specific applications, including porcelain enamel clays.

We feature air-floated clays from our 6 modern air-floating mills.
Also available: lump and disintegrated form.

Serving the Ceramic Industry with quality clays since 1889.

TENNESSEE BALL CLAYS

Wade No. 5	Martin No. 5	No. 9 Ball	No. 10 Ball	No. 1 SGP	Ray Ball	Miss. M & D
Brown	Light Gray	Gray	White to Gray	Gray	Dark Brown to Black	Gray
.50	Trace	.11	.05	.08	.72	Trace
Lignitish	Siliceous	Lignitish	Siliceous	Siliceous	Lignitish	Lignitish
52.0	36.00	34.4	33.6	42.5	47.2	40.0
5.8	6.0	4.0	3.4	4.7	6.2	5.6
17.4	11.7	11.5	12.5	18.0	15.2	14.9
19.8	14.7	14.5	14.8	16.8	19.1	15.2
.30	9.7	10.8	7.2	11.2	10.5	.20
.00	3.9	2.2	4.2	2.4	.4	.00
Gray White	Cream	Cream White	White	White	Gray White	Deep Ivory

—ALL ABOVE CONE 15—

33 1/4	31 1/4	32	32	33	32	30
482	276	305	206	286	410	Above 1000
43.82	60.72	51.04	49.72	49.08	49.64	57.03
35.91	25.53	29.38	33.20	34.02	28.35	27.92
.782	1.39	1.82	1.82	1.51	1.43	1.31
.964	.744	1.01	1.04	.845	.621	2.17
.12	.08	.65	.08	.31	.42	.46
Trace	Trace	.77	.22	Trace	.44	.30
2.01	1.72	1.30	.73	.88	1.33	.49
.42	.40	.43	.41	.58	.62	.36
15.95	9.35	13.38	12.85	12.92	17.30	9.78

Dark, strong, excellent casting. Low dope requirement, excellent drainage. High PCE. High alumina. Non-thixotropic.

Coarse grained, very fast casting. Low dope, long deflocculation range. Non-thixotropic, low shrinkage.

Medium strength, fast oxidizing. Excellent extruding and pressing and heat shock properties.

Medium strength, fast oxidizing, excellent extruding and pressing properties.

Medium strength, good casting, extruding and pressing properties. Excellent fired color. High PCE.

Strong, coarse grained, excellent casting. Drainage at high viscosity.

Exceedingly strong fine grained. Excellent pressing, extruding and jiggering properties.

Cast, pressed, jiggered and extruded products.

All cast products. Also extruded and pressed.

Extruded and pressed products. Heat shock bodies.

Extruded and pressed products. Excellent floor tile clay.

Cast, pressed, extruded and jiggered products. High alumina refractory. Steatite and special porcelain.

Cast, pressed, extruded and jiggered products.

All pressed, extruded and jiggered products. Maximum bonding properties.

PLASTIC FIRE CLAYS

Black Monroe Wad	Light Monroe Wad	No. 3350 Clay	Benpink
Black	Buff	Light Gray	Light Pink
Trace	Trace	Trace	.03%
Siliceous	Siliceous	Siliceous	Siliceous
37.8	30.6	25.8	37.3%
6.5	5.7	4.8	6.39
11.1	9.9	10.5	12.5
12.7	11.3	11.0	16.28
16.0	13.0	8.5	10.7
11.6	8.3	4.3	.73
Gray	Gray	Lt. Ivory	Ivory

—ALL ABOVE CONE 15—

30	30	28-29	32
307	224	590	333
62.64	65.80	60.82	54.20
22.71	21.62	25.58	31.10
1.18	1.28	1.70	1.05
1.07	1.54	1.32	1.65
Trace	.34	.47	.14
None	.40	.42	.16
.97	.38	.34	.88
.29	.39	.22	.56
11.24	8.04	9.30	10.23

Dark plastic wad clay

Light, low shrinking wad clay.

Strong, low shrinking high silica clay. Excellent pressing and extruding properties.

Plastic refractory clay, higher alumina and PCE.

All wadding purposes.

All wadding purposes and refractory cements.

Bond clay for refractories, re-torts, etc.

To improve pressing and extruding properties, all type products.

Laboratory controlled.



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Alliance, Ohio • Mayfield, Kentucky • Paris, Tennessee

Write for additional information and samples.



NEENAH, WISCONSIN

New Clay Conditioner—Additive-A*

GENERAL DESCRIPTION:

Kimberly-Clark Additive-A is a new clay conditioner in liquid form that is easily added to the tempering water with multiple benefits in brick, structural clay products and clay pipe production. It greatly improves plasticity and strength, results in more efficient production,

higher yields and a more profitable operation. Kimberly-Clark Additive-A is the result of six years of laboratory experimenting and three years of plant testing. It is a field tested product now being used to great advantage in the production of millions of brick.

HERE ARE SOME OF THE MANY BENEFITS YOU GET FROM ADDITIVE-A CLAY CONDITIONER

At the Pug Mill

Additive-A helps water penetration, increases plasticity and promotes even temper in the raw clay. Less water is needed and anti-scum chemicals can be reduced in quantity or eliminated.

At the Auger and Die

Additive-A reduces power consumption. It acts as a lubricant, promoting easy extrusion of the column. Longer life of augers, dies, and liners is experienced with less downtime for replacing parts. This increased body lubrication also reduces lamination.

The Column on the Belt

Greater plasticity is definite. This with the reduction in water content produces a denser column with considerably greater wet green strength. Ware is more easily handled without damage.

On the Drier Car

Because of the stiffer column, hacking damage is appreciably reduced. Block or package setting and fork handling are possible with all clays. Crushing is reduced making hacks more stable.

In the Drier

It allows faster drying at higher temperatures, yet markedly reduces drier cracks. Dry green strength has made package setting possible in many plants.

In the Kiln

Additive-A helps to produce cleaner, brighter colors. Fired ware made with Additive-A is less subject to thermal and mechanical shock damage.

In the Yard

Better body preparation results in improved strength. Because there is less shrinkage, you have more uniformity in size. Products are easily handled, packaged, and color is more uniform.

In Shipment

Because of the tougher, more uniform product better packaging and strapping is possible with less breakage and chippage in transit and in loading and unloading.

*Additive-A is a trademark of Kimberly-Clark Corporation—U.S. Pat. 2,839,415. Other pat. pending.

PROPERTIES:

Additive-A is a compound material, completely water soluble. It is a lubricating liquid. It is not flammable.

Specific Gravity—approximately 1.280.

Viscosity—at 40°F. (recommended minimum temperature)—1350 centipoises.

Weight—10.6 Pounds per gallon.

SHIPPING:

Commercial shipments are made by railway tank car or by tank truck, whichever is more convenient or economical to the customer.

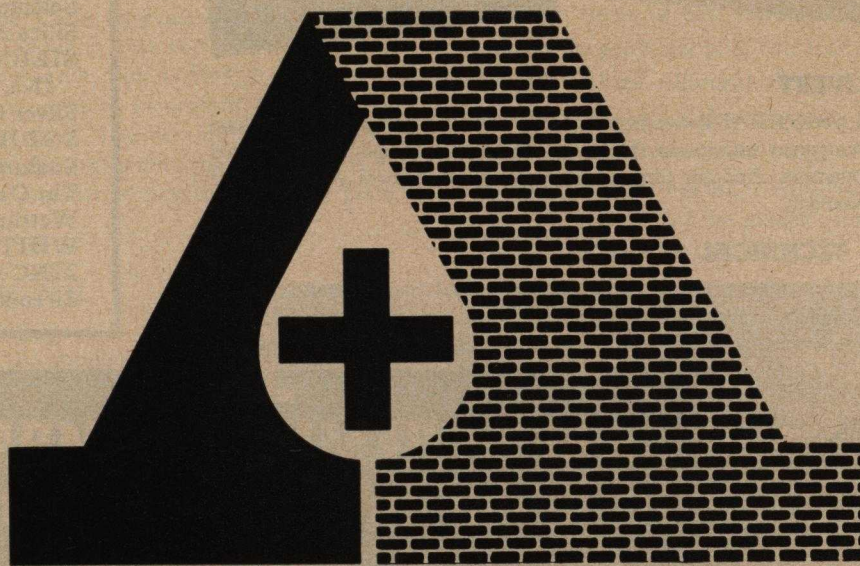
Tank trucks are unloaded by a pump on the truck. Railway tank cars must be unloaded by the customer.

STORAGE:

Bulk storage may be in steel tanks. It is recommended that Additive-A temperature be kept above 40°F. for ease in pumping.

HOW TO FIND OUT MORE ABOUT ADDITIVE-A CLAY CONDITIONER

Write Chemical Products, Kimberly-Clark Corporation, Neenah, Wisconsin. We will send you a booklet describing what Additive-A has done for other clay manufacturers. If you wish, we will be glad to have one of our representatives call on you to discuss the application of Additive-A to your production.



ADDITIVE-A

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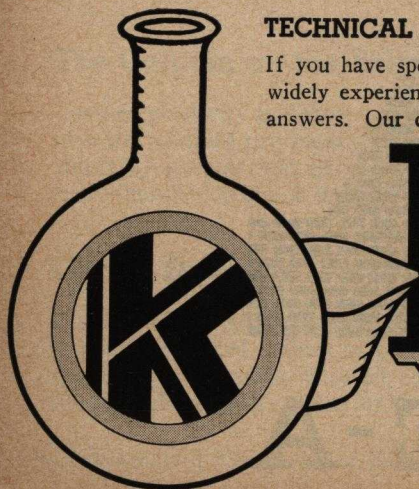
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If you have special problems or unusual requirements, let our widely experienced technical staff help you work out the right answers. Our cooperation is as practical as it is wholehearted.

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Chromic Acid
COBALT COMPOUNDS
Copper Oxide
Copper Compounds
CRYOLITE
Cyanides (Cu, K, Na, Zn)
FELDSPAR
Gum Arabic & Tragacanth
Iron Compounds
LITHARGE
LITHIUM CARBONATE
Magnesium Compounds
Manganese Dioxide
Metal Powders
Mica
Molybdenum Oxide
NEPHELINE SYENITE
Nickel Sulfate
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Oils—All kinds
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Salt Cake
SALTPETER
Selenium
Silica & Silicates
SILICOFLUORIDES
(Na, K)
Silver Salts
SODIUM ANTIMONATE
Sodium Fluoride
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WHITE LEAD
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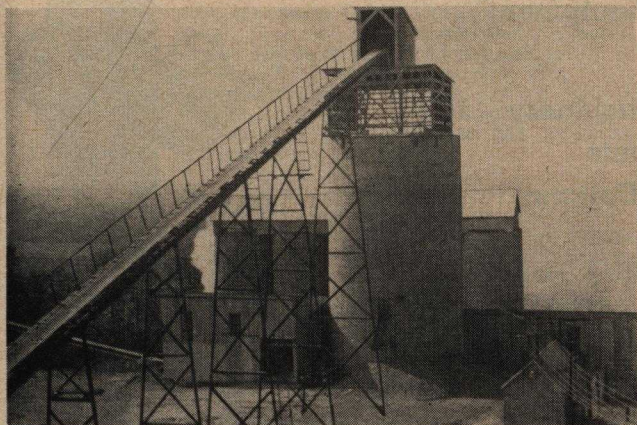
Oldest and Largest Producer of Kyanite Concentrate in the World

BLUE CRYSTAL VIRGINIA KYANITE AND MULLITE

PRODUCT

VIRGINIA BLUE CRYSTAL KYANITE is the result of extensive research and laboratory testing. High in alumina and low in iron Virginia Kyanite is used world-wide by the Ceramic and other industries.

MULLITE is produced by continuous treatment in rotary kilns at cone 16-18 (Approximately 2700F) until conversion to Mullite is complete. Both KYANITE and MULLITE are available in grain sizes -35, -48, -100 and -200 mesh.



Partial view of Willis Mountain facilities

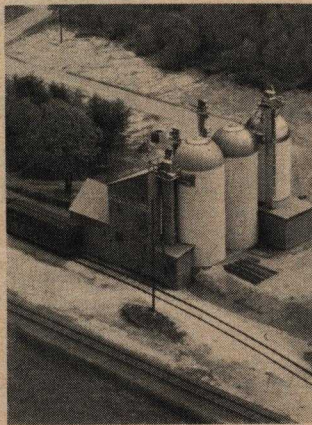
USES

VIRGINIA KYANITE is primarily a super-refractory, showing a Pyrometric Cone equivalent value of 36-37 (3300 degrees F.) Its value is best shown when used in high-percentage in the batch, that is 50-85%. However, its beneficial effects are evident in certain compositions when only 5 to 10% is used. The flexibility of Kyanite's performance warrants the statement that Virginia KYANITE should be of interest to practically every plant in the Ceramic field.

IMPARTS STRENGTH

In addition to resisting extreme temperatures, the interlocked mullite crystals of KYANITE impart great strength and load-resisting properties. Thus it is an ideal component of firebrick and tile, saggars, kiln furniture and refractory shapes of many kinds. Since it also has excellent resistance to the corrosive action of molten glass, KYANITE is of value in all glasshouse refractories.

RAW KYANITE has the property of expanding under firing heat, the degree of expansion depending on the grain size and the amount of heat applied. This characteristic is well utilized in the manufacture of porous refractories such as insulating brick, and to a lesser extent in high-temperature cements and mortars where fine grained raw KYANITE or a mixture of raw and calcined are producing excellent results. For this latter service the straight calcined product is also used. KYANITE's ability to increase dielectric resistance as well as body strength makes it a valuable constituent of electrical and refractory porcelain.



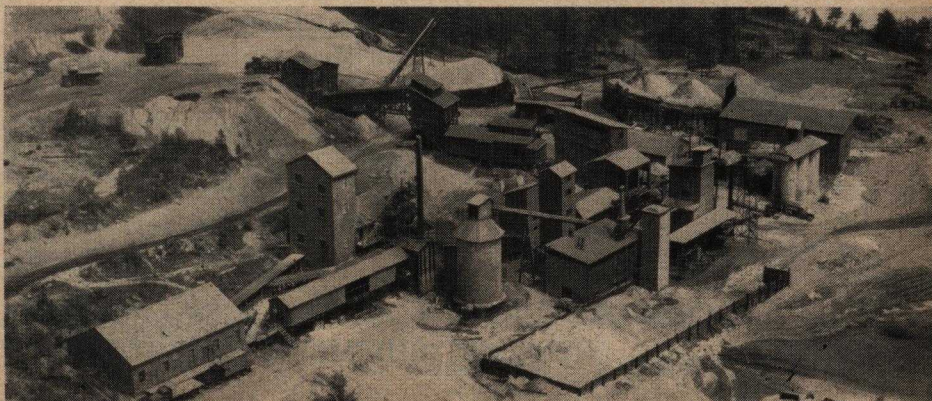
Pamplin Storage Plant

SERVICE

Completion of a new plant on ore-rich Willis Mountain more than doubles the production capacity of KYANITE MINING CORPORATION and assures quick deliveries of KYANITE and MULLITE. Facilities at Baker's Mountain have been improved and storage facilities are located at Pamplin. The newest development at Willis

Mountain, in Buckingham County, Virginia contains several million tons of high grade ore.

Although demand has increased rapidly, the increased capacity to produce, plus the fact that the facilities are served by three different railway companies, means a constant flow of highest quality KYANITE without undue delay. Prices, analysis and grain-size data are available for the asking. Samples, from one pound to several hundred, will be gladly sent without charge.



Aerial view of Baker's Mountain Plant

LAWLER COMPANY

DURHAM AVE. & L.V.R.R.

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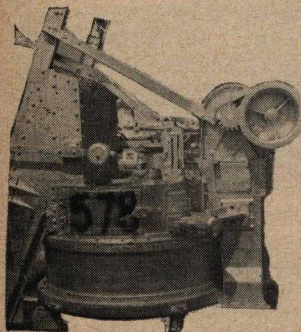
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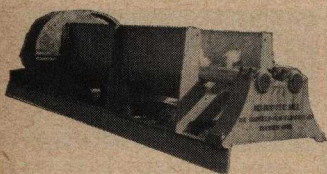
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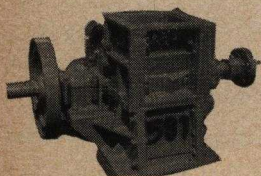
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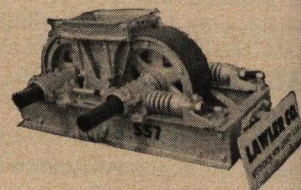
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Your idle Machinery
represents
Your idle Dollars

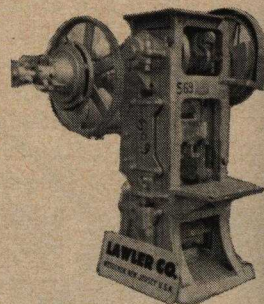
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ing . . . Remanufacturing from the
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when practical.

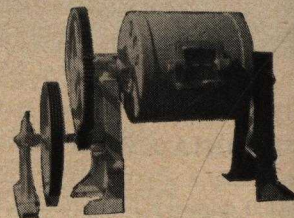
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Roll crusher



Repress



Pebble mill

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Agitators
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Blungers
Boilers
Brick Machines
Bucket Elevators
Cars
Compressors
Conveyors

Crushers—Jaw-Roll
Disintegrators
Dryers-Kilns
Extruders
Feeders
Filters
Furnaces
Locomotives
Mills—Ball-Pebble

Mills—Hammer
Mills—Pug
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Pans—Dry-Wet
Presses
Pulva-sizers
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Pumps—Diaphragm,
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Trucks—Fork Lift

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From raw materials to finished product, from research lab to production line, Leeds and Northrup instruments are doing an outstanding job for hundreds of ceramic manufacturers. These technically advanced products are helping new plants get the maximum from modern facilities . . . enabling older plants to substantially increase their production quotas by the close measurement and control of the

many variables encountered in the high-quality mass manufacture of ceramic products.

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INSTRUMENTS FOR INDUSTRIAL PROCESS MEASUREMENT & CONTROL



L&N Speedomax® Type G electronic null-balancing instruments are widely used for precise measurement of temperature, pH, conductivity, speed, O₂ concentration, and many other quantities. Available as single-point, round-chart recorders, or single or multiple-point strip-chart recorders, Speedomax G can be equipped for two-position or proportioning control . . . is extremely versatile in application.



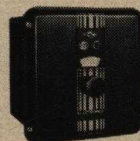
L&N Furnace Pressure Controllers provide both small-step, high-sensitivity regulation for normal pressure changes and high-speed, continuous adjustment for large deviations . . . regulate dampers to maintain control-pressure regardless of variations in combustion conditions, fuel supply or outside atmosphere.



L&N Speedomax Type H instruments fill the demand in many applications where compact, economical equipment must indicate, record or control. Both round-chart and strip-chart models are available for two-position control, and may be equipped for proportioning types of electric control. Indicators and indicating controllers are also available.



L&N Gas Analysis recording equipment comprises the Magnetic Oxygen Analyzer for combustion control, the Chromomax® gas chromatograph and L&N Infra-Red Analyzer for process gases, and the Thermal Conductivity Analyzer for binary gases.



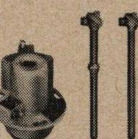
L&N Electromax® Signalling Controllers provide accurate temperature regulation where indicating or recording is not required. These instruments may be used with either L&N thermocouples or the highly stable L&N Thermohm® (resistance thermometer).



L&N Liquid Analysis equipment includes both portable and panel-mounted indicators for pH, Redox and electrolytic conductivity measurements, and the L&N Electro-Chemograph® for the finest in accurate polarographic analysis.



L&N Speedomax Model D Indicators enable operators to check up to 126 critical temperatures at remote points in any system accurately . . . rapidly. The operator merely switches to the desired thermocouple and a drum-type scale spins to the measured temperature.



L&N Temperature Detectors are available in three types: L&N Rayotube® (heat radiation) detectors, for temperatures to 4000 F and above; L&N base-metal and noble-metal thermocouples for applications ranging from sub-zero to 2800 F; and L&N Thermohm® (resistance thermometer) detectors, for temperatures to 1000 F.

INSTRUMENTS FOR PLANT & LABORATORY CHECKING & TESTING



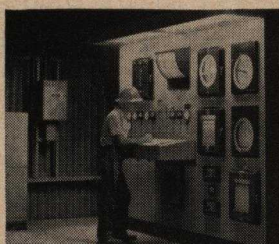
L&N Optical Pyrometers provide fast, accurate temperature measurements for calibration of automatic instruments or intermittent readings in kiln, tank or furnace. Simple in operation, these potentiometer-type instruments are rugged industrial type pyrometers performing service on hundreds of installations.



L&N Portable Temperature Indicators are battery-operated, completely self-contained. Indicators for use with thermocouples are calibrated in millivolts for precise checks or measurements, or calibrated directly in degrees for routine checking or measurement.

SYSTEMS ENGINEERING

L&N Systems Engineering is more than good design; it is the correct combination of industry-proved instruments and controls correctly applied to your process by teamwork between experienced L&N engineers and your production and engineering staff. For new plants or modernization programs, a call to your nearest L&N office can help bring the answer to your instrumentation problems.



L&N High Precision bridges, potentiometers, galvanometers, standards and accessory equipment are widely used for the precise measurement of voltage, current, resistance, etc.

LEEDS & NORTHRUP
Instruments Automatic Controls • Furnaces

THE LOUTHAN MANUFACTURING COMPANY

SUBSIDIARY OF FERRO CORPORATION • EAST LIVERPOOL, OHIO

HIGH FIRE



KILN FURNITURE

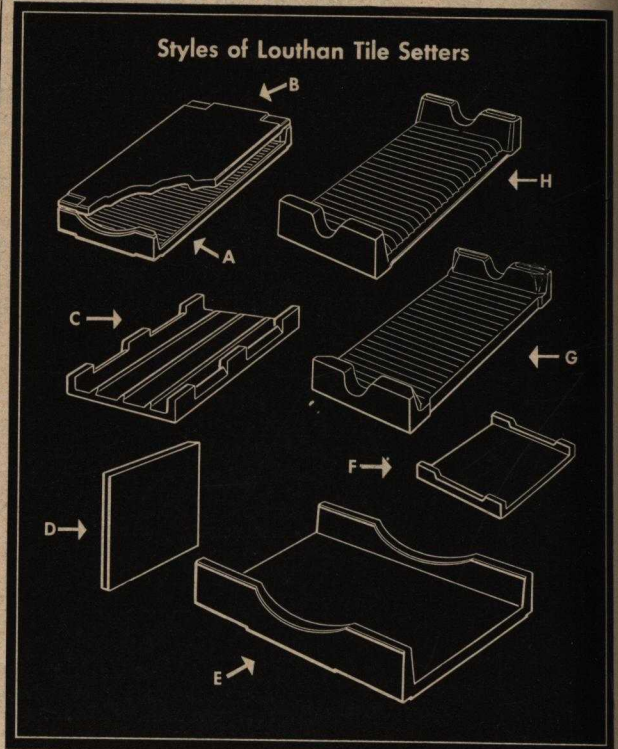
LOUTHAN IMPROVED TILE SETTERS

Louthan new, improved tile setters bring greater efficiency to the firing of tile, last longer and thus reduce setter costs. Their dense, smooth surface reduces to a minimum production losses due to kiln dirt. Will withstand fast firing cycles

from cone 06 to cone 11, without dunting, cracking, or spalling. Will not oxidize, grow, or lose their mechanical strength from continued use. Structurally strong to withstand abnormal handling. Designed for easy, secure stacking. Louthan offers a full range of sizes for every need.

LOUTHAN IMPROVED TILE SETTERS

Die No.	Use	Style	DIMENSIONS			Placing Space	No. Per Ctn.	Av. Wt. Per Ctn.
			Width	Length	Height			
6214	4 1/4"	A	4 3/4"	10 1/4"	1 1/4"	4 3/4 x 9 5/16 x 23 5/16"	30	53 lbs.
6215	4 1/4"	A	4 3/4"	10 1/4"	1 1/16"	4 3/4 x 9 5/16 x 1 1/16"	21	40 lbs.
6199	Cover	B	4 3/4"	10 1/4"	7/16"	4 3/4 x 10 1/4"	44	62 lbs.
6454	4 1/4"	A	4 3/4"	10 1/4"	1 1/16"	4 3/4 x 9 5/16 x 23 5/16"	30	55 lbs.
6455	4 1/4"	B	4 3/4"	10 1/4"	7/16"	4 3/4 x 10 1/4"	44	62 lbs.
6294	4 1/4"	G	4 3/4"	10 3/4"	1 1/16"	4 1/2 x 9 1/2 x 5 5/8"	30	55 lbs.
6392	4 1/4"	G	4 3/4"	10 3/4"	1 1/16"	4 3/4 x 9 5/16 x 1 1/16"	30	54 lbs.
6353	4 1/4"	G	4 3/4"	10 3/4"	1 1/2"	4 1/2 x 9 1/2 x 1"	24	51 lbs.
6297	Cover	B	4 3/4"	10 3/4"	7/16"	4 3/4 x 10 3/4"	36	51 lbs.
6404	4 1/4"	G	4 3/4"	10 3/4"	1 1/4"	4 1/2 x 9 1/2 x 5 5/8"	30	55 lbs.
6405	4 1/4"	B	4 3/4"	10 3/4"	7/16"	4 3/4 x 10 3/4"	44	65 lbs.
6247	4 1/4"	A	4 3/4"	10 3/4"	1 1/4"	4 3/4 x 9 5/16 x 1 1/16"	30	54 lbs.
6329	4 1/4"	A	4 3/4"	10 3/4"	1 1/16"	4 3/4 x 9 5/16 x 3/4"	30	58 lbs.
6350	4 1/4"	A	4 3/4"	10 3/4"	1 1/2"	4 3/4 x 9 5/16 x 1 1/16"	24	47 lbs.
6248	Cover	B	4 3/4"	10 3/4"	7/16"	4 3/4 x 10 3/4"	44	66 lbs.
5737	4 1/4"	C	5 3/8"	9"	1 1/8"	4 7/16 x 9 x 5 5/8"	30	52 lbs.
6005	Cover	D	5 3/8"	9"	3/8"	5 3/8 x 9"	50	67 lbs.
6351	4 1/4"	C	5 3/4"	9 1/4"	1 1/8"	4 7/8 x 9 1/4 x 5 5/8"	30	57 lbs.
6370	Cover	B	5 3/4"	9 1/4"	7/16"	5 3/4 x 9 1/4"	40	61 lbs.
6181	Special	A	6"	10 7/8"	1 1/4"	6 x 10 x 3/4"	24	49 lbs.
6244	Special	A	6"	10 7/8"	1 1/2"	6 x 10 x 1"	20	50 lbs.
6182	Cover	B	6"	10 7/8"	7/16"	6 x 10 7/8"	24	48 lbs.
6327	6x9"	A	6 1/2"	10 3/4"	1 13/32"	6 1/2 x 9 5/8 x 5 5/16"	16	45 lbs.
6328	Cover	B	6 1/2"	10 3/4"	7/16"	6 1/2 x 10 3/4"	28	65 lbs.
6407	4 1/4 x 6"	G	6 1/2"	10 3/4"	1 1/2"	6 x 9 1/2 x 5 5/8"	16	39 lbs.
6408	Cover	B	6 1/2"	10 3/4"	7/16"	6 1/2 x 10 3/4"	32	65 lbs.
6008	Floor	F	6 1/2"	8"	3/4"	6 1/2 x 7 x 1 5/8"	40	65 lbs.
6045	Floor	F	6 1/2"	8"	1 1/16"	6 1/2 x 7 x 3/4"	40	65 lbs.
6054	6"	A	6 1/2"	8"	1 1/16"	6 1/2 x 7 x 5/8"	30	65 lbs.
6377	Cover	B	6 1/2"	8"	7/16"	6 1/2 x 8"	40	60 lbs.
6338	Floor	F	8"	7"	7/8"	7 1/8 x 7 x 1 1/2"	30	62 lbs.
6448	Floor	G	7 1/2"	8 1/2"	5/8"			
6434A	Special	G	7 1/4"	9 1/2"	3/4"	9 1/4 x 6 3/8 x 1 1/2"	12	25 lbs.
6217	6"	G	6 1/2"	14"	1 9/16"	6 1/2 x 13 x 1 1/16"	14	56 lbs.
6216	6"	G	6 1/2"	14"	1 3/4"	6 1/2 x 13 x 1 1/4"	14	56 lbs.
6393	6"	G	6 1/2"	14"	1 1/16"	6 1/2 x 13 x 3/4"	14	52 lbs.
6398	6"	G	6 1/2"	14"	1 9/16"	6 3/4 x 13 x 1 1/16"	14	60 lbs.
6399	6"	H	6 1/16"	13 15/16"	1 5/8"	6 1/16 x 13 x 3/4"	14	53 lbs.
6415	6"	H	7"	14"	2 1/2"	6 3/4 x 13 x 1 1/4"	12	53 lbs.
6243	Cover	B	6 1/2"	14"	1 1/2"	6 1/2 x 13"	15	53 lbs.
6412	6"	A	7"	15"	1 9/16"	7 x 14 x 1"	14	53 lbs.
6138	Quarry	E	8"	12 7/8"	2 5/8"	6 11/16 x 12 7/8 x 1 7/16"	50	415 lbs.
6264	Trim	A	6"	11 1/4"	2 5/8"	6 x 10 x 2"	15	60 lbs.
6291	Trim	A	6"	11 1/4"	2 1/2"	6 x 10 x 1 1/2"	18	69 lbs.
6265	Trim	B	6"	11 1/4"	7/16"	6 x 11 1/4"	24	50 lbs.
6240	Floor	F	10 1/2"	13"	2 13/16"	9 x 13 x 2"	6	55 lbs.
6367	Floor	H	10 1/4"	14 1/4"	1 3/8"	10 1/4 x 13 1/4 x 3/4"	6	35 lbs.
6041	Shelf	D	9 9/16"	10 1/2"	1/2"	9 9/16 x 10 1/2"	11	43 lbs.
5689	Shelf	D	4"	4"	3/8"	4 x 4"	144	54 lbs.
5688	Shelf	D	5"	5"	3/8"	5 x 5"	80	53 lbs.
5683	Shelf	D	6"	6"	3/8"	6 x 6"	60	60 lbs.
5774	Shelf	D	6"	10"	3/8"	6 x 10"	40	68 lbs.
6088	Shelf	D	6 1/4"	6 1/4"	3/8"	6 1/4 x 6 1/4"	52	62 lbs.
5422	Shelf	D	8"	8 3/8"	3/8"	8 x 8 3/8"	30	57 lbs.
6288	Shelf	D	8"	10 7/8"	9/16"	8 x 10 7/8"	18	62 lbs.
5757	Shelf	D	9"	9"	7/16"	9 x 9"	19	50 lbs.
6096	Shelf	D	9"	17"	3/4"	9 x 17"	5	48 lbs.
6387	Shelf	D	10"	14"	7/16"	10 x 14"	12	52 lbs.
5884	Shelf	D	11"	12"	9/16"	11 x 12"	11	57 lbs.
6235	Shelf	D	11 3/4"	11 3/4"	1"	11 3/4 x 11 3/4"	6	60 lbs.
6355	Shelf	D	10"	14 3/4"	1"	10 x 14 3/4"	6	61 lbs.
5773	Shelf	D	14 1/2"	14 1/2"	3/4"	14 1/2 x 14 1/2"	4	50 lbs.



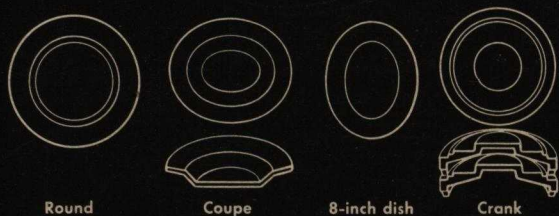
STANDARD SETTERS (RIGHT)

Louthan Setters for Chinaware and Semi-vitreous Porcelain Dinnerware (see right-hand page) have set new standards for the industry. They withstand repeated fires without warping or sagging, are mechanically rugged and highly resistant to thermal shock. Precision-formed to insure perfect alignment, they are low and compact to permit extra ware per bung in same headroom. They also have added utility in green room, offsetting losses due to faulty boards. Full range of types and sizes available.

CHINAWARE SETTERS FOR VITRIFIED CHINA

DINNERWARE SETTERS FOR SEMI-VITREOUS PORCELAIN

Styles of Louthan Chinaware Setters for Vitrified China



Round

Coupe

8-inch dish

Crank

Type B

Type D

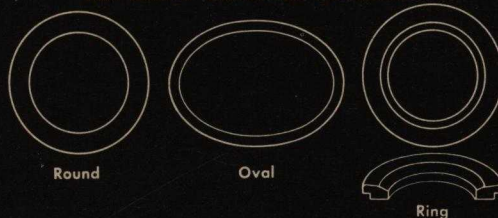
Type E

Die No.	Type Shape	DIMENSIONS			No. Per Ctn.	Av. Wt. Per Ctn.
		Overall Diameter	Placing Diameter	Thick-ness		
5598	A Round	8 1/4"	7"	5/8"	30	46 lbs.
5542	C Round	6 1/8"	5 1/8"	3/16"	80	50 lbs.
5691	C Round	7"	6 1/4"	1/2"	34	32 lbs.
5615	C Round	9 3/4"	8 3/4"	13/16"	12	30 lbs.
5564	C Round	12 3/8"	11 1/4"	3/8"	10	50 lbs.
6189	G Round	4 9/16"	4 9/16"	5/8"	60	39 lbs.
6055	G Round	8 1/8"	8 1/8"	3/8"	30	53 lbs.
5988	G Round	9 3/4"	8 3/4"	13/16"	11	41 lbs.
6114	H Round	6 1/8"	6 1/8"	1/2"	72	67 lbs.
6033	H Round	7"	7"	1/2"	30	46 lbs.
6135	H Round	7"	7"	5/8"	30	44 lbs.
5603	H Round	8 1/4"	8 1/4"	5/8"	30	48 lbs.
6034	H Round	8 1/2"	8 1/2"	5/8"	20	63 lbs.
6003	H Round	9 3/4"	9 3/4"	3/4"	11	40 lbs.
5558	H Oval	9 3/8x12 5/8"	9 3/8x12 5/8"	3/4"	10	44 lbs.
5927	F Ring	6 3/8"	6 3/8"	3/4"	48	37 lbs.
5806	F Ring	6 7/8"	6 1/2"	13/16"	24	28 lbs.
6208	F Ring	7"	6 3/4"	3/4"	26	32 lbs.
5829	F Ring	7 1/16"	6 3/8"	3/8"	26	31 lbs.
5807	F Ring	7 3/4"	7 1/4"	3/8"	22	30 lbs.
6209	F Ring	7 3/4"	7 1/16"	13/16"	22	32 lbs.
5828	F Ring	8 1/16"	7 3/8"	3/8"	24	35 lbs.
5808	F Ring	9"	8 5/8"	3/8"	26	43 lbs.
5833	F Ring	9"	8 5/8"	1 5/8"	12	35 lbs.
6210	F Ring	9"	8 13/16"	13/16"	26	45 lbs.
5788	F Ring	9 7/8"	9 3/8"	3/8"	10	19 lbs.
6066	F Ring	9 7/8"	9 1/2"	1 1/4"	8	26 lbs.
5804	F Ring	10 1/4"	9 3/4"	1"	9	23 lbs.
5790	F Ring	10 1/2"	10"	3/8"	10	25 lbs.
5819	F Ring	11 1/4"	11"	3/8"	9	29 lbs.
5858	F Ring	11 1/4"	10 3/4"	1"	9	32 lbs.
5922	F Ring	11 1/4"	10 5/8"	1"	9	30 lbs.
5805	F Ring	11 3/8"	10 3/4"	1"	9	32 lbs.
5984	F Ring	12 1/16"	11 3/8"	1"	9	34 lbs.

LOUTHAN CHINAWARE SETTERS

Die No.	Type Shape	DIMENSIONS			No. Per Ctn.	Av. Wt. Per Ctn.
		Overall Diameter	Placing Diameter	Thick-ness		
6128	B Round	5 5/8"	5 1/16"	1 1/16"	72	48 lbs.
6011	B Round	5 3/4"	5 1/8"	1 1/2"	52	48 lbs.
6115	B Round	6 1/8"	5 5/8"	1 1/16"	76	55 lbs.
6229	B Round	6 1/8"	5 5/8"	1 1/16"	76	63 lbs.
6010	B Round	6 1/2"	5 5/8"	1 1/4"	26	32 lbs.
6118	B Round	6 13/16"	6 1/2"	1 5/16"	34	39 lbs.
6230	B Round	6 7/8"	6 9/16"	3/8"	34	44 lbs.
6127	B Round	7"	6 1/2"	1 1/16"	26	32 lbs.
6116	B Round	7 5/8"	7 1/4"	1"	32	44 lbs.
6062	B Coupe	7 3/4"	7 1/4"	1 3/8"	26	32 lbs.
6000	B Round	8"	5 1/4"	1 5/16"	30	51 lbs.
6202	B Round	8 3/8"	8"	1 1/16"	34	48 lbs.
6168	B Round	8 5/8"	8 3/8"	1 1/16"	32	55 lbs.
5548	B Round	8 7/8"	7"	1 1/16"	30	56 lbs.
6087	B Coupe	9 1/8"	8 3/4"	2"	22	51 lbs.
6112	B Coupe	9 5/16"	9 1/4"	2 1/16"	8	21 lbs.
6049	B Round	9 3/8"	9"	1"	12	29 lbs.
6169	B Round	9 5/8"	9 3/8"	1"	12	27 lbs.
6023	B Round	10 3/8"	9 3/4"	1 1/4"	12	33 lbs.
6318	B Round	10 3/8"	9 3/4"	1 1/8"	12	33 lbs.
6228	B Coupe	10 1/2"	10"	1 13/16"	10	30 lbs.
6326	B Coupe	10 1/4"	9 3/4"	1 5/8"	10	30 lbs.
6117	B Round	10 5/8"	10 5/16"	3/8"	14	33 lbs.
5547	B Round	11 1/4"	9"	1 7/16"	10	39 lbs.
6126	B Round	11 3/8"	11 3/16"	1"	13	35 lbs.
6042	B Round	11 3/8"	11"	1 3/16"	11	42 lbs.
6219	B Round	11 7/16"	11 3/16"	1 3/16"	11	43 lbs.
6060	B Round	12 1/8"	11 7/8"	1 3/16"	12	46 lbs.
6098	B 8" Dish	12x15 3/4"	9 3/16x13"	1 11/16"	9	44 lbs.
5863	D Round crank	7 1/8"	5 3/8"	1 1/16"	18	24 lbs.
5897	D "	7 5/8"	7"	1 1/8"	18	25 lbs.
6024	D "	8 3/8"	6 13/16"	1 1/4"	16	34 lbs.
5913	D "	9 5/16"	8 3/4"	1 1/8"	8	19 lbs.
6025	D "	10"	8 3/8"	1 3/8"	7	19 lbs.
5878	D "	12"	10 1/2"	1 3/16"	6	32 lbs.
6026	D "	12"	10 3/16"	1 1/2"	5	23 lbs.
6027	E Round crank	8 3/8"	7 3/4"	1 3/4"	6	18 lbs.
6028	E "	11"	9 3/4"	1 3/8"	8	37 lbs.
6029	E "	13 1/4"	11 7/8"	2 1/16"	6	46 lbs.
6212	E "	13 1/4"	11 3/16"	3 1/2"	3	37 lbs.

Styles of Louthan Dinnerware Setters for Semi-Vitreous Porcelain



Round

Oval

Ring

Type A

Rim setter with boss

Type C

Rim setter without boss

Type G

Flat setter with boss

Type H

Flat setter without boss

Type F

Sandless ring setter

SEE NEXT PAGE
for firing racks and pottery supplies

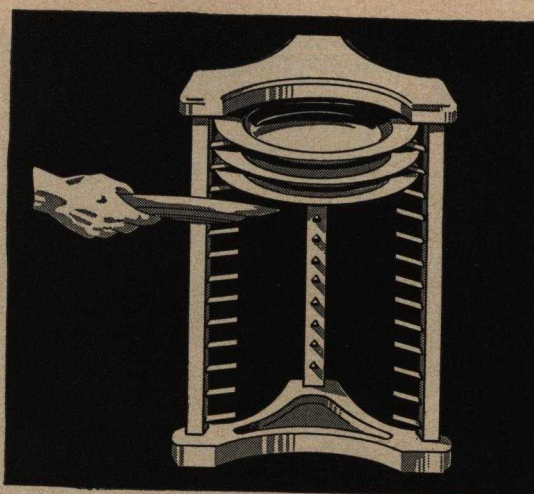
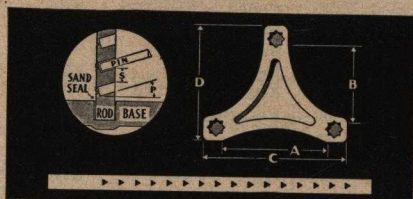
THE LOUTHAN MANUFACTURING COMPANY (Cont.)

LOUTHAN HIGH FIRE REFRACTORY FIRING RACKS

An all-refractory Firing Rack offering a simplified method of placing glost ware. Made of Kirox (Kyanite base), resistant to thermal shock and extremely rugged to withstand rough handling. Minimized equipment needs and flexibility in usage are featured advantages. Each Rack is made up of Crown, Base and 3 Rods . . . all refractory. Racks assemble and disassemble readily. Parts require but one-sixth the storage space of saggers. With LOUTHAN Racks, placing may be done from the top down, insuring cleaner ware.

CROWNS AND BASES come in a full range of sizes to provide clearance for all sizes of flatware from 3" saucers up. RODS, punched to take standard pins on common spacings, come in varying lengths to meet kiln requirements and are interchangeable.

PITCH OF PINS.
Alternates in pitch provided . . . one style for standard ware and the other for thin ware to fully utilize kiln space.



BASE AND CROWN SIZES AND SPECIFICATIONS

Base or Crown No.	Dimensions				Net Weight Per 100	
	A	B	C	D	Base	Crown
H-1-S	11 1/2"	7 1/16"	14 3/16"	10 1/4"	340 lbs.	196 lbs.
H-1	10 1/8"	6 3/4"	13 3/16"	9 3/4"	313 lbs.	144 lbs.
H-2	9 1/16"	6 1/16"	12 3/16"	9 3/8"	294 lbs.	163 lbs.
H-3	8 1/4"	5 1/16"	11 1/4"	8 1/4"	250 lbs.	125 lbs.
H-4	7"	4 3/4"	9 1/16"	7 3/4"	215 lbs.	110 lbs.
H-5	6"	3 1/2"	8 1/16"	6 1/2"	175 lbs.	90 lbs.
H-6	5 1/8"	3 3/8"	8 1/8"	6 1/8"	156 lbs.	81 lbs.

ROD SIZES AND SPECIFICATIONS

Rod No.	Rod Length	No. Pin Holes	Pin Angle "P"	Pin Spacing "S"	Net Weight per 100
1	10 1/4"	9	15°	9/16"	55 lbs.
2	14 3/8"	13	7°	5/8"	75 lbs.
3	14 3/8"	15	7°	3/2"	75 lbs.
4	14 3/8"	13	15°	9/16"	75 lbs.
5	18 3/8"	13	7°	1 1/16"	100 lbs.
6	18 3/8"	17	7°	5/8"	100 lbs.
7	18 3/8"	20	7°	1/2"	100 lbs.
8	18 3/8"	17	15°	9/16"	100 lbs.
9	14 3/8"	9	7°	1 1/16"	75 lbs.
10	14 3/8"	15	7°	7/8"	80 lbs.

RECOMMENDATIONS

Base or Crown No.	Commonly Used For
H-1-S	10" Plates
H-1	7", 7 1/2" and 8" Plates
H-2	7", 7 1/2" and 8" Plates
H-3	5", 5 1/2" and 6" Plates
H-4	3", 4", 4 1/4" Plates; 4", 4 1/2" Fruits
H-5	3", 3 1/2" Fruits; A.D. Saucers
H-6	3", 3 1/2" Fruits; A.D. Saucers

NOTE: All weights are approximate.

LOUTHAN POTTERY SUPPLIES

Louthan manufactures a complete line of dependable pottery supplies, including Pins, Posts, Spurs, Stilts and Thimbles. These important items are precision-made, clean, true and uniform. Available in a full range of sizes.

PLACING PINS Standard and Double Point

LOUTHAN High Fire Pins are scientifically made by the de-aired pugging of selected clays. Warp-age is reduced to a minimum. They are clean, white, uniform and true. Will resist thermal shock in cooling section of fastest kiln.

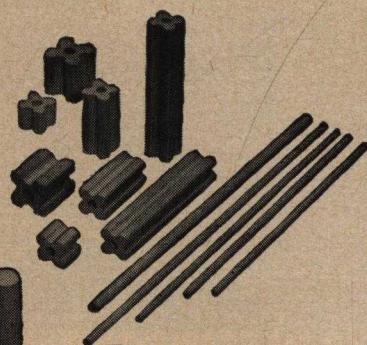


PLACING PINS

Stock No.	Plate and Saucer	Dish	Wash Bowl
4	1 1/2"	1 1/2"	1 1/2"
5	1 3/4"	1 3/4"	1 3/4"
6	2"	2"	2"
7	2 1/4"	2 1/4"	2 1/4"
8	2 1/2"	2 1/2"	2 1/2"
9	2 3/4"	2 3/4"	2 3/4"
10	3"	3"	3"
11	3 1/4"	3 1/4"	3 1/4"

SETTER POSTS

Louthan Setter Posts are made in two styles—round and fluted square cross-section. Both designs are shown at the right and below. Available in various diameters and lengths. Write for details.



TILE SETTER PINS

Tubular and solid Tile Setter Pins are made in any length up to 15 inches, and diameters of 5/16", 11/32", 3/8", 7/16" and 1/2".



THE LOUTHAN MANUFACTURING CO.

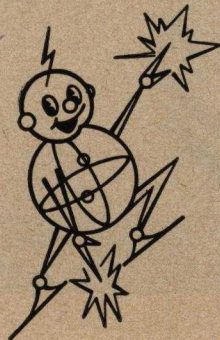
A Division of Ferro Corporation
EAST LIVERPOOL, OHIO

LITHIUM CORPORATION OF AMERICA, INC.

1108 TITLE INSURANCE BLDG., MINNEAPOLIS 1, MINN.

CERAMIC LITHIUM COMPOUNDS

Lithium Aluminate (LiAlO_2)
Lithium Metaborate, Dihydrate ($\text{LiBO}_2 \cdot 2\text{H}_2\text{O}$)
Lithium Carbonate (Li_2CO_3)
Lithium Cobaltite (LiCoO_2)
Lithium Manganite (Li_2MnO_2)
Lithium Molybdate (Li_2MoO_4)
Lithium Silicate (Li_2SiO_3)
Lithium Titanate (Li_2TiO_3)
Lithium Zirconate (Li_2ZrO_3)
Lithium Zirconium Silicate ($\text{Li}_4\text{ZrSiO}_6$)



Improve Quality . . . Cut Costs . . . Boost Production

Ceramic Lithium compounds aid in producing higher quality enamels and glazes while reducing costs and increasing plant output.

These compounds, developed especially for the industry by L.C.A., are probably the most powerful fluxes known today. Small percentages of them as either smelter or mill additions are remarkably effective. According to extensive plant tests and production runs, they offer the following advantages. They lower firing temperatures and/or shorten firing time. They improve workability and eliminate defects. Moreover, they increase gloss, opacity and acid resistance.

All of the Ceramic Lithium compounds are available immediately in experimental or commercial quantities.

FOR ENAMELS

Ground Coats and Colored Single Coats

As a mill addition in the large scale production of ground coats and colored single coats, Lithium Manganite offers the following advantages:

A. Reduces firing temperature 30° to 60° F., and/or shortens firing time comparatively, depending upon individual plant conditions to:

1. Permit use of non-premium steel by eliminating warpage.
2. Eliminate separate firing schedules for ground and cover coats.
3. Reduce fuel costs or . . .
4. Boost production by shortening firing time.

B. Improves workability by reducing viscosity and surface tension to:

1. Save frit by allowing thinner application.
2. Improve quality by providing smoother application.
3. Increase productivity for same reason.

C. Improves quality by:

1. Increasing acid resistance in some cases, even at lowered firing temperature.
2. Improving bond and thermal shock resistance.
3. Minimizing fish scaling and reboiling.

As a smelter addition, Lithium Cobaltite enhances the effect of Lithium Manganite to produce these benefits:

A. Cuts costs by reducing amount of cobalt oxide required in some frit combinations.

B. Saves fuel and eliminates warpage by lowering firing temperature of hard, blue, single-coated, acid-resistant enamels to the range of normal ground and cover coats.

C. Improves quality by helping to retain satisfactory color.

As a mill addition in black, acid-resistant enamels, Lithium Titanate offers the following advantages:

A. Eliminates warpage, saves fuel and boosts production by reducing firing temperature and/or shortening firing time.

B. Improves bond even at lower temperatures or shorter firing time.

Leading ceramic plants all over the world report enthusiastically on the benefits obtained from Ceramic Lithium compounds. These users claim "high temperature" quality from "low temperature" enamel frits and all the other advantages of lower firing temperatures. Some say that even those enamels already in the category of "low temperature" can be improved substantially by mill additions of Ceramic Lithium compounds.

For Cover Coats

As mill additions in titanium-bearing enamels, Lithium Titanate, Lithium Zirconate and Lithium Zirconium Silicate offer the following advantages:

- A. Lower firing temperature and/or shorten firing time.
- B. Improve gloss and opacity.
- C. Increase reflectance.
- D. Eliminate black specking.

As a smelter addition, Lithium Silicate effects a substantial lowering of firing temperatures.

Other Ceramic Lithium compounds which are being studied and show great promise for the enameler are: Lithium Molybdate, Lithium Aluminate and Lithium Borate.

FOR GLAZES

Ceramic Lithium compounds aid in producing better glazes at lower cost. The viscosity is lowered and fluidity increased. As a result, eggshelling and pinholing are virtually eliminated. Moreover, indications are that bubbles are either eliminated or greatly reduced in size.

Another apparent effect of mill additions of these compounds is the widening of the firing range of glazes. Consequently, a uniformly high quality glaze is produced at the top, middle and bottom of the kiln.

According to reports of users, these compounds give a higher gloss to glazes under certain conditions. This is especially valuable with underglaze colors . . . a higher gloss and greater transparency is obtained without any running of the color.

Because of their strong fluxing power and non-volatile nature, small percentages of these compounds would naturally be effective. This use of small percentages minimizes their relatively high coefficient of expansion . . . makes for better glaze fit. It also makes them inexpensive to use.

Lithium Titanate, Lithium Zirconate and Lithium Zirconium Silicate are especially interesting because of their insolubility in water. Their strong fluxing power and chemical stability makes them valuable in vitreous, semi-vitreous and raw sanitary ware glazes. Lithium Silicate may be added to this list, but only as a frit component.

For Abrasives

Lithium Manganite serves as a bonding agent for large diameter grinding wheels, improving the strength by increasing wetting of the abrasive grains.

FOR FURTHER INFORMATION ON CERAMIC LITHIUM COMPOUNDS AND HOW THEY CAN SOLVE YOUR PROBLEMS, WRITE TO LITHIUM CORPORATION OF AMERICA, INC.

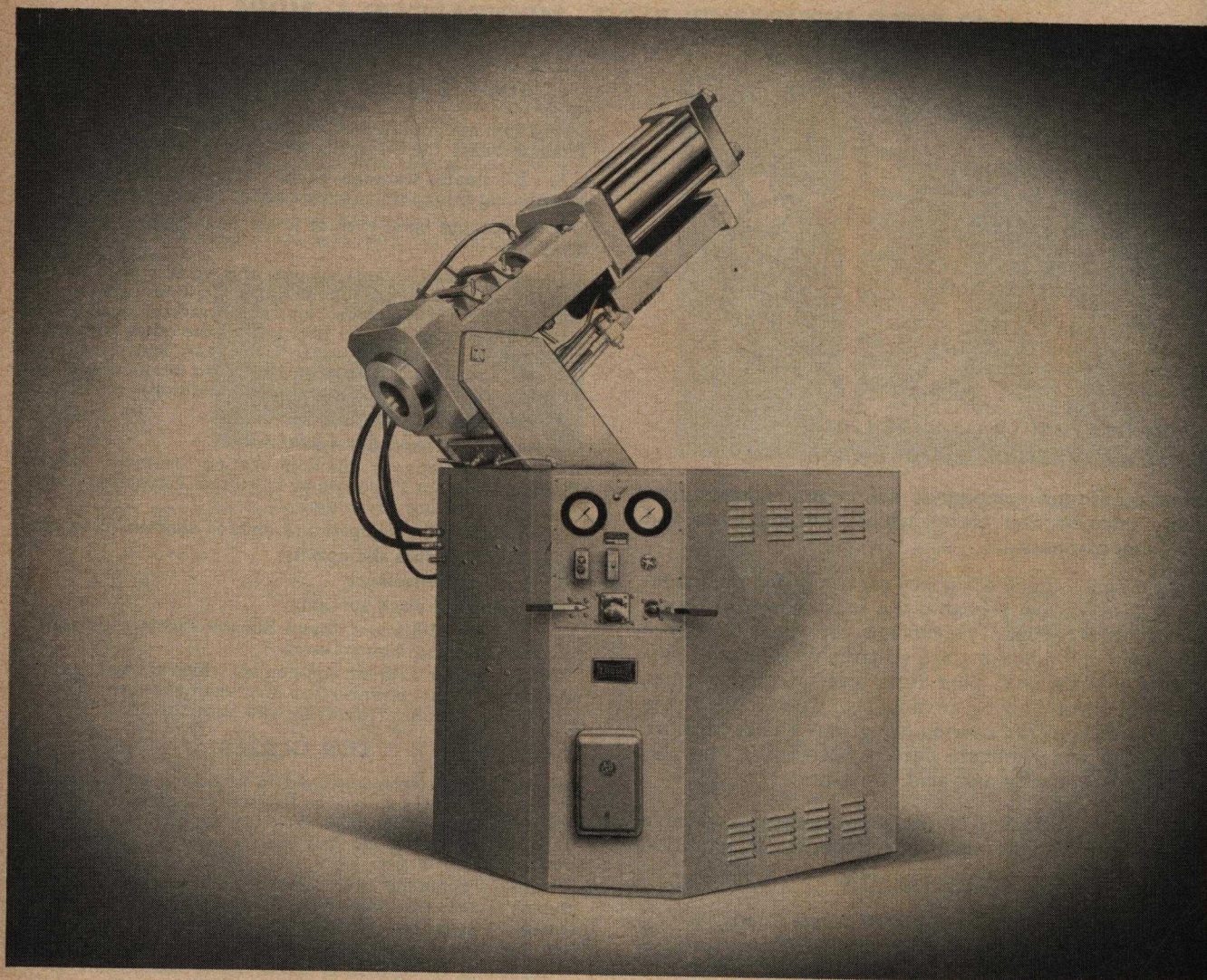


LITHIUM CORPORATION
OF AMERICA, INC.

1108 TITLE INSURANCE BLDG.
MINNEAPOLIS 1, MINN.

LOOMIS ENGINEERING AND MANUFACTURING CO.

Route 46, Caldwell, N. J.



HYDRAULIC PRESSES WITH HYDRAULIC TILTING FEATURES

We manufacture a complete range of Hydraulic Ceramic Extrusion Presses from laboratory to largest production capacities.

Here Are Some of the Important Features

- Extrudes in horizontal, vertical, or inclined positions to suit size and shape of extrusion.
- Convenience of quick loading in vertical position.
- All controls in panel mounted for convenience and accessibility of operator.
- Easier method of installation and removal of dies provided.
- Built to solve your toughest extrusion problems of . . . Aluminum Oxide . . . Ferrite . . . Steatite . . . Nuclear and Refractory Materials . . . Carbon.

Also Ceramic Injection Molding - Porosity Testing - Isostatic Molding Presses - Cut-off Machines

INQUIRE ABOUT OUR POWER-OPERATED AND HAND-OPERATED
HYDRAULIC COMPRESSION PRESSES.

THE McGEAN CHEMICAL CO.

1040 MIDLAND BLDG., CLEVELAND, OHIO

Branches

Detroit
Grand Rapids
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Ceramic Chemicals

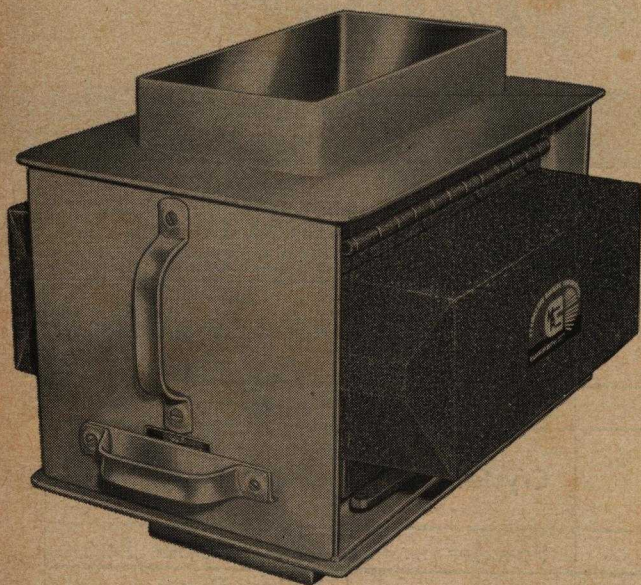
Material	Formula	Color	Form	Package
TIN OXIDE	SnO_2	White	Powder	50 # Drum 100 # Drum 250 # Drum
MAXOPAQUE	Porcelain Enamel Opacifier	White	Powder	400 # Barrel
ANTIMONY OXIDE	Sb_2O_3	White	Powder	50 # Paper Bag
ANTIMONY SULFIDE (Powdered Needle Antimony)	Sb_2S_3	Black	Crystal	400 # Barrel
SODIUM ANTIMONATE	NaSbO_3	White	Powder	50 # Paper Bag
COBALT CARBONATE	CoCO_3	Pink	Powder	100 # Drum 250 # Drum
COBALT OXIDE	CoO	Black	Powder	10 # Can 350 # Keg
COBALT SULFATE	CoSO_4	Red	Powder	100 # Drum 400 # Drum
CADMIUM CARBONATE	CdCO_3	White	Fine Crystal	100 # Drum
CADMIUM SULFATE	$3\text{CdSO}_4 \cdot 8\text{H}_2\text{O}$	White	Crystal	100 # Drum
CADMIUM OXIDE	CdO	White	Powder	50 # Can
CHROMIC ACID	CrO_3	Red	Flakes	100 # Drum
CHROMIUM OXIDE	Cr_2O_3	Green	Powder	50 # Paper Bag
COPPER OXIDE (Cupric)	CuO	Black	Powder	100 # Paper Bag
COPPER OXIDE (Cuprous)	Cu_2O	Red	Powder	100 # Drum
NICKEL CARBONATE	NiCO_3	Blu-Green	Powder	50 # Drum 100 # Drum 150 # Drum
NICKEL OXIDE	NiO	Black	Powder	100 # Drum 500 # Barrel 900 # Barrel
NICKEL OXIDE	NiO	Green	Powder	100 # Drum 350 # Drum
NICKEL SULFATE	$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$	Blue	Fine Crystal	100 # Bag
SELENIUM	Se_8	Grey	Powder	100 # Drum 200 # Drum
MANGANESE DIOXIDE	MnO_2	Black	Powder	100 # Paper Bag

Supplementing these products manufactured in our Cleveland Plant, a complete line of basic ceramic materials are available.

MAGNI-POWER COMPANY

WOOSTER, OHIO, U. S. A.

MAGNI-POWER MAGNETIC FILTERS For Removal of Micron Size Ferrous Contamination



Magni-Power offers the absolute finest in the filtering of micron type of fine ferrous contamination from ex-

tremely high density dry materials such as dry ceramic body stock, frits, sands, chemicals, etc., as well as liquids such as, ceramic body slips, paints, porcelain enamels, etc.

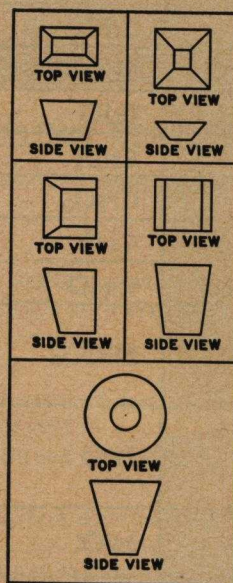
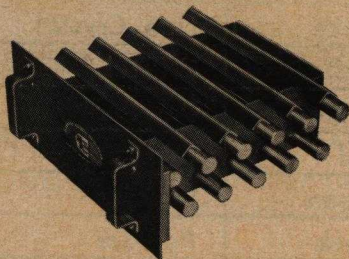
The permanent magnetic filter is an exclusive development of Magni-Power Company's research department.

When the unit is applied on applications of unaerated, high density dry materials, a high frequency vibrator is incorporated as a component part to maintain constant flow and compensate for moisture variations.

Principle of operation consists of one or two banks of Alnico V castings energizing by induction, hundreds of Magnetic prongs inside the insert filtering chamber. As uncleansed material flows through the series of energized prongs, ferrous metallic particles are grasped. The magnetic prongs hold them securely while allowing them to move in material flow direction and store themselves on the underside of energized prongs, completely out of the flow line, giving the unit unexcelled capacity.



Grid magnets provide low cost elimination of gross ferrous contamination in free flowing materials. Grids are offered in single bank or drawer type as shown, with removable tubes for easy cleaning, in lengths $3\frac{1}{2}$ - $39\frac{1}{2}$ " in 2" increments and widths 4 - 40" in 4" increments. Stainless steel deflector and tube construction standard, other materials optional.



Typical Chute Applications

Basic design flexibility assures easy installation and efficient separation in square, rectangular or round chutes.

For further information request technical bulletin



MAGNI-POWER CO.
Wooster, Ohio Dept. C



ECONOMY

EFFICIENCY

DEPENDABILITY

industrial DRYERS



Designed



Built



REFRACTORY DRYERS

... the problem dictates the design

Batch Type Humidity Controlled Dryer with Car Pullers and Automatic Door Control system

Progressive Type Humidity Controlled Quarry Tile Dryer

Conveyorized Lay-Down Dryer

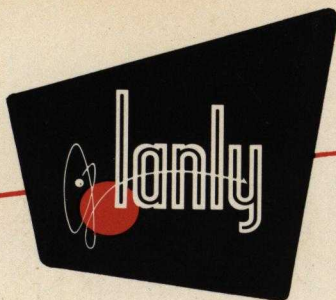
The LANLY Company's geographical location is near the heart of the country's clay products producing area. This has contributed to their 20 year acquisition of the essential knowledge and experience required to design and build the finest in heat processing equipment for the exacting varied applications in the industry.

Unprecedented competition, coupled with ever increasing costs has made it mandatory for clay products manufacturers to strengthen their relative positions in the field through the replacement of outmoded dryers. This has been accomplished in a large measure by their coordinated action with the LANLY organization.



COMPANY

... over twenty years of serving industry

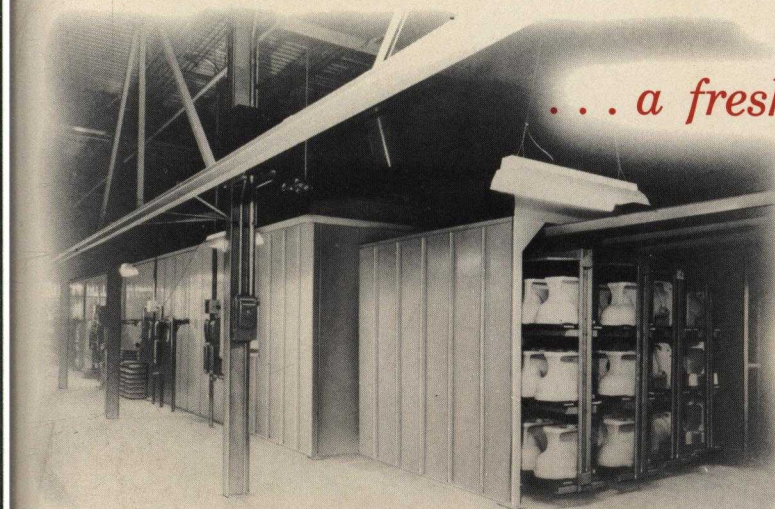


SANITARY-WARE DRYERS

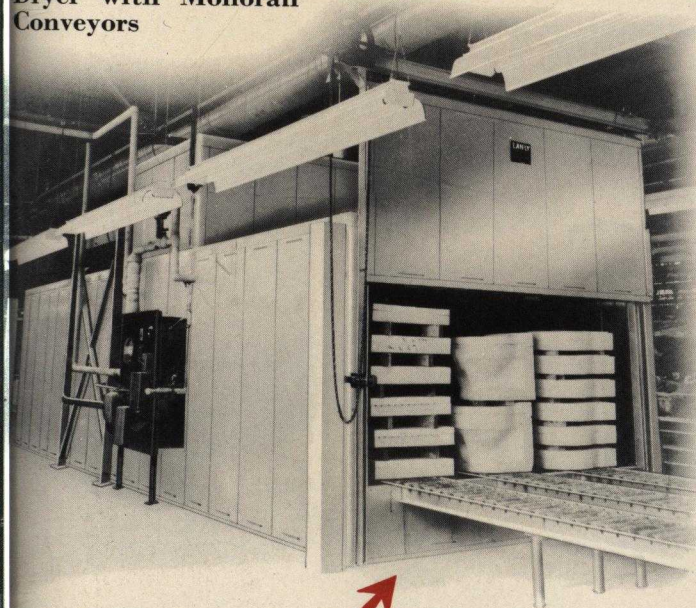
... a fresh approach thru coordination

The LANLY approach to a typical heat processing operational problem as a separate case rather than adapting a standard design as a cure-all for any drying problem, has met with a welcome reception by the trade.

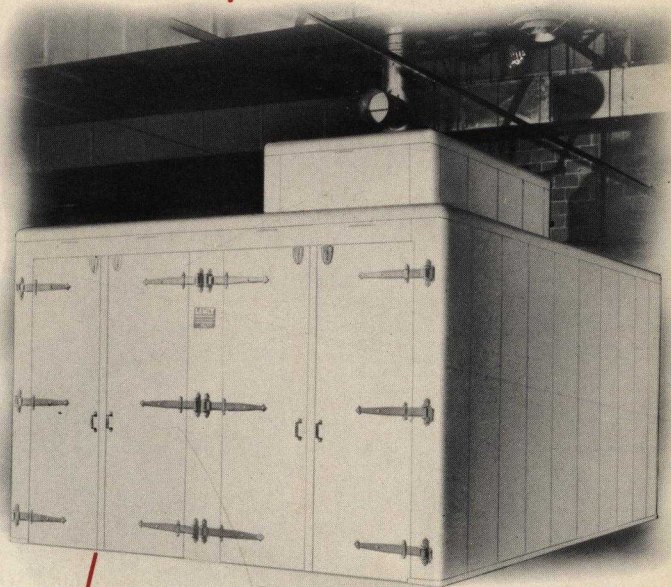
This fresh approach and the introduction of new materials and equipment into the LANLY design program has helped bring about revolutionary drying rates and ware uniformity. The resultant LANLY installations are producing a greater volume of clay products at a reduced unit cost and with a minimum of rejects.



**Progressive Type Ware
Dryer with Monorail
Conveyors**



**Conveyorized Mold
Dryer**

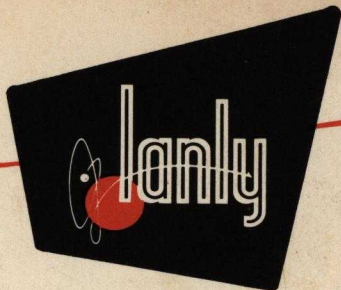


**Batch Type Humidity
Controlled Ware Dryer**



COMPANY

... over twenty years of serving industry

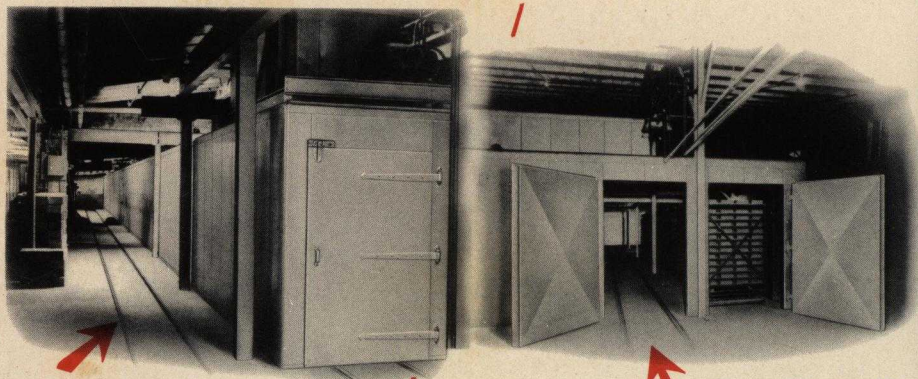


VARI-PURPOSE DRYERS

TYPICAL USERS

American Lava Corp.
Amer. Rad. & Std. Sanitary Corp.
American-Standard Prod., Ltd.
American Vitrified Prod. Co.
Atlantic Tile Mfg. Co.
Babcock & Wilcox Co.
Carborundum Co.
Celotex Corp.
Clay City Pipe Co.
Corundite Refractories, Inc.
Crane Co., Ltd.
Dickey, W. S. Clay Co.
Eljer Company
Evans Pipe Co., The
Frontenac Fl. & Wall Tile, Ltd.
General Tile Corp.
Gladding, Mc-Bean & Co.
Graff-Kittanning Clay Prod. Co.
Harbison-Walker Refract. Co.
Ingersoll-Humphries Co.
Jordan Tile Co.
Kohler Co.
Larson Clay Pipe Co.
Logan Clay Products Co.
Massillon Refractories Co., The
Mosaic Tile Co.
Natco Corp.
National Plumbing Pottery Co.
New Castle Refractories Co.
North Amer. Refract. Co.
Oconee Clay Products Co.
Patterson Foundry & Mach. Co.
Pomona Terra-Cotta Co.
Pope-Gosser China Co.
Robinson Clay Products Co.
Simonds Worden White Co.
Stillwater Clay Products Co.
Streator Drain Tile Co.
Tillotson Refractories Co.
U. S. Quarry Tile Co.
Universal Potteries, Inc.
Utah Fire Clay Co.

Bulletin 572

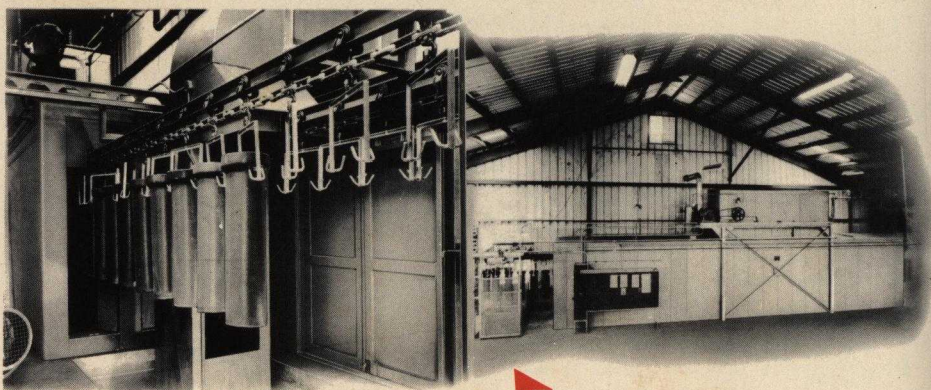


Progressive Tile Dryer

Car Type Humidity
Controlled Fire Brick
Dryer

... Work-tested design features

- ♦ Rounded corners, buried supporting steel and built-in heaters for a simple, compact, streamlined appearance.
- ♦ Insulated panel enclosed duct work to eliminate the need for field applied insulation.
- ♦ Greater air circulation to insure closer temperature uniformity and more rapid drying.
- ♦ Automatic reversing air flow to insure a uniform drying rate and to provide equal treatment to all ware by the heated air.
- ♦ Aluminum construction increases dryer and duct work life. It eliminates the problem of rust laden air and moisture spotting the ware.
- ♦ Custom design to meet each individual application.



Continuous Pre Heat
and Plastisol Curing
Oven



COMPANY

heat processing equipment

cleveland 14, ohio

LITHO U.S.A.

MASON COLOR & CHEMICAL WORKS, INC.

ESTABLISHED IN 1842

206-214 Broadway

P. O. Box 76

East Liverpool, Ohio

PRECISION-MADE AMERICAN CERAMIC COLORS

Glaze Stains Body and Engobe Stains	A new line of low cost stains. Finely ground for use on dinnerware - artware - wall tile - structural clay products - sanitary ware.
Underglaze Colors	For use in any type of underglaze decoration requiring a finely ground color. Excellent for copper plate printing, hand painting or spraying.

To facilitate easy handling and to avoid undue contamination in use, our colors are packed a maximum of 125 lbs. to the drum. Smaller units also available.

Silk Screen Colors	A full palette of Underglaze and Overglaze colors prepared in our new medium for silk screen work. Excellent workability - will not seep through the screen; fluffy; readily dried in air or by mechanical means; smooth; hard setting; easily handled prior to firing.						
Overglaze Colors	Complete line available for dinnerware, artware, etc.						
Decorating Oil and Mediums	<table><tr><td>Prepared Mediums</td><td>Lavendar Oil</td></tr><tr><td>Prime Fat Oil</td><td>Oil of Cloves</td></tr><tr><td>Balsam of Copaiba</td><td>Silk Screen Mediums</td></tr></table> Araco Gum for underglaze - water soluble, requires no hardening on.	Prepared Mediums	Lavendar Oil	Prime Fat Oil	Oil of Cloves	Balsam of Copaiba	Silk Screen Mediums
Prepared Mediums	Lavendar Oil						
Prime Fat Oil	Oil of Cloves						
Balsam of Copaiba	Silk Screen Mediums						

The Color Harmony Manual of the Container Corp. of America may be used as reference in matching your colors. Just send us the code identification number.

Representatives	G. S. Robins & Co.	Witco Chemical Co.	Witco Chemical Co.
	126 Chouteau Ave.	3460 Wilshire Blvd.	80 Stonestown
	St. Louis 2, Mo.	Los Angeles 5, Calif.	San Francisco 27, Calif.

McDANIEL REFRACTORY PORCELAIN CO.

510 Ninth Avenue

Beaver Falls, Pa.



Porcelain and High Density Grinding Balls • Porcelain and Super High Density Lining Brick • Mill Door Lining Blocks • Special Frame Brick • Mill Head Assemblies • Metal Covered and Porcelain Lab Jars



McDaniel
PRJ-1G
LAB MILL
JAR

A new 1-gallon lab jar . . . designed with recessed bronze hardware for roller-type or cradle-type lab mills, has smooth, long-wearing, high-grade ceramic body. Easily cleaned inside and out. Close fitting cover rests on a soft rubber gasket . . . can be tightened without cracking. Doesn't leak. Neoprene gaskets optional.

PRJ-1G Specifications

Actual Capacity 5 qts.
Overall Height 11 $\frac{1}{8}$ in.
Overall Diameter 8 $\frac{7}{8}$ in.
Hardware Bronze (except Screws)
Gasket Rubber (Neoprene optional)

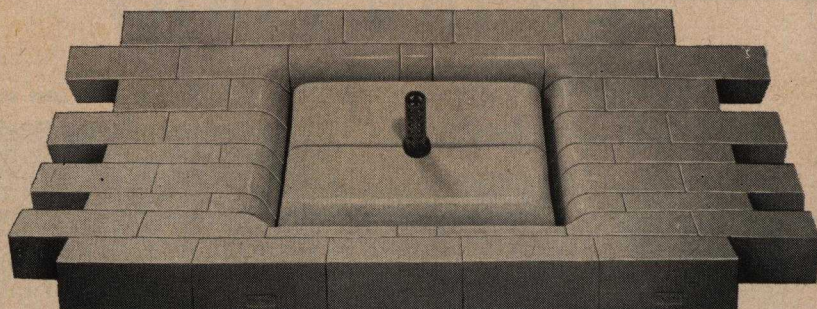


McDaniel Metal Covered Laboratory Grinding Jars

Accurately duplicates ball mill grinding action. Easy to handle, quickly discharged and cleaned. Jar is protected by shell of heavy-gauge steel. Fits standard cradles. Can be equipped with rubber tires for use on roller-type mills. Parts replaceable from stock any time.

Metal Covered Jar Specifications

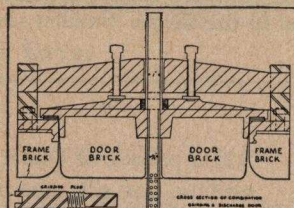
Jar For Cradle-Type Mills	MCJ1Q	MCJ1G	MCJ2G
Jar with Tires for Roller Mills	MCJT1Q	MCJT1G	MCJT2G
Capacity designation	1 qt.	1 gal.	2 gal.
Actual capacity	1 $\frac{1}{4}$ qts.	4 $\frac{3}{4}$ qts.	11 qts.
O.D. (overall)	5 $\frac{3}{4}$ "	8 $\frac{7}{8}$ "	11 $\frac{1}{8}$ "
Height (overall)	7 $\frac{1}{4}$ "	10 $\frac{5}{8}$ "	12 $\frac{5}{8}$ "
I.D. (overall)	4 $\frac{3}{4}$ "	7 $\frac{1}{4}$ "	9 $\frac{3}{8}$ "
Depth (inside)	4 $\frac{1}{4}$ "	7 $\frac{1}{4}$ "	9 $\frac{1}{4}$ "
Charge (porcelain balls)	2 lbs. $\frac{3}{4}$ "	7 lbs. 1" 3 lbs. $\frac{3}{4}$ "	10 lbs. 1" 5 lbs. 1 $\frac{1}{2}$ "



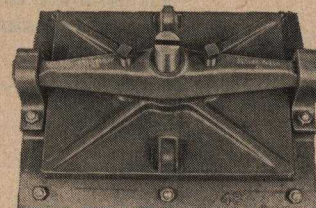
McDaniel Mill Head Assemblies Cover All Metal—Less Contamination

A specially designed, overhanging-type door frame brick and door block completely covers all metal parts. Gives you a real custom-fit lining. Your old door and mill head assemblies can easily be replaced with

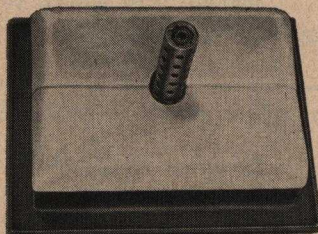
the McDaniel Mill Head Assembly. Specify also when you buy a new mill from any manufacturer. We furnish all necessary metal parts and gaskets.



Cross-Section View

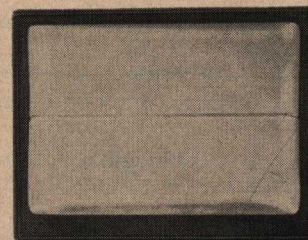


Full Assembly—Outside View



Discharge Plug Substituted for Grinding Plug—
Inside View

McDaniel Mill Head Doors need not be removed to discharge when wet grinding. Replace grinding plug with perforated discharge plug for quick, easy discharge. No partially ground material around door gets into the batch.



Solid Door for Dry Grinding—Inside View

Dry grinding door is identical except for hole in center. Performance records show longer mill head service and greater batch purity with McDaniel Mill Head Assemblies. Washout Doors also available.

Listed here are sizes for most Ball Mills—includes all necessary metal parts and gaskets

McDANIEL MILL HEAD ASSEMBLIES

Mill Size	Catalog No. with Combination Door	Catalog No. with Grinding Door	Opening Required in Mill Shell*
16"	MHA 16 CD	MHA 16 GD	6 $\frac{1}{4}$ " x 8 $\frac{3}{8}$ "
18"	MHA 18 CD	MHA 18 GD	
21"	MHA 21 CD	MHA 21 GD	
24"	MHA 24 CD	MHA 24 GD	9 $\frac{3}{4}$ " x 13 $\frac{1}{4}$ "
30"	MHA 30 CD	MHA 30 GD	
36"	MHA 36 CD	MHA 36 GD	11 $\frac{1}{4}$ " x 15 $\frac{1}{4}$ "
42"	MHA 42 CD	MHA 42 GD	
48"	MHA 48 CD	MHA 48 GD	
54"	MHA 54 CD	MHA 54 GD	
60"	MHA 60 CD	MHA 60 GD	
72"	MHA 72 CD	MHA 72 GD	
84"	MHA 84 CD	MHA 84 GD	
96"	MHA 96 CD	MHA 96 GD	

*Small pieces can be welded in or cut out and bolt holes relocated if opening on your mill is different size.

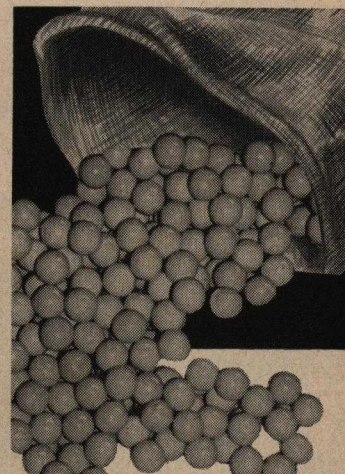
McDANIEL REFRACTORY PORCELAIN CO.

510 Ninth Avenue

Beaver Falls, Pa.



Porcelain and High Density Grinding Balls • Porcelain and Super High Density Lining Brick • Mill Door Lining Blocks • Special Frame Brick • Mill Head Assemblies • Metal Covered and Porcelain Lab Jars



McDaniel High Density Lining Brick

McDaniel Super High Density Mill Lining Brick last $2\frac{1}{2}$ to 3 times longer than standard porcelain brick. It's harder, tougher, and gives you lower mill operating costs.

McDaniel Porcelain Lining Brick

McDaniel Porcelain Mill Linings are made of specially developed vitreous porcelain . . . low in glass content with a tough, stony structure. Affords excellent resistance and long wear. Low cost.

A complete range of brick sizes to line every mill. Linings for conical continuous mills, too.

Table of Dimensions

McDANIEL SUPER HIGH DENSITY BRICK					
Catalog No.	Approximate Dimensions			No. Bricks Per Ctn.	
	Thickness	Base	Top	Length	
1500	$1\frac{1}{2}$ "	$1\frac{3}{4}$ "	$1\frac{3}{4}$ "	6"	42
1400	$1\frac{1}{2}$ "	$2\frac{1}{8}$ "	$2\frac{1}{2}$ "	6"	30
1450	$1\frac{1}{2}$ "	$2\frac{1}{8}$ "	$2\frac{3}{8}$ "	6"	30
1650	$1\frac{1}{2}$ "	$2\frac{1}{8}$ "	2"	6"	32
1900	$1\frac{1}{2}$ "	2"	$1\frac{3}{4}$ "	6"	40
2350	2"	$2\frac{3}{4}$ "	2"	6"	24
2400	2"	$2\frac{1}{8}$ "	2"	6"	24
2950	2"	$2\frac{1}{8}$ "	2"	6"	24
2500*	$2\frac{1}{2}$ "	2"	2"	6"	20
2800	$2\frac{1}{2}$ "	$2\frac{1}{4}$ "	2"	6"	20
2450	$2\frac{1}{2}$ "	$2\frac{1}{8}$ "	2"	6"	20

Note: *No. 2500 is for lining mill ends. Can be installed as a 2" or $2\frac{1}{2}$ " lining.

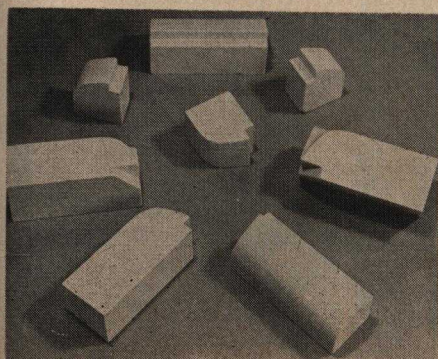
Table of Dimensions

McDANIEL STANDARD PORCELAIN BRICK					
Catalog No.	Approximate Dimensions			No. Bricks Per Ctn.	
	Thickness	Base	Top	Length	
150	$1\frac{1}{2}$ "	$1\frac{3}{4}$ "	$1\frac{3}{4}$ "	6"	49
195	$1\frac{1}{2}$ "	$1\frac{1}{8}$ "	$1\frac{3}{4}$ "	6"	48
190	$1\frac{1}{2}$ "	2"	$1\frac{3}{4}$ "	6"	48
185	$1\frac{1}{2}$ "	$2\frac{1}{8}$ "	$1\frac{3}{4}$ "	6"	42
295	2"	$2\frac{1}{8}$ "	2"	6"	30
240	2"	$2\frac{1}{8}$ "	2"	6"	30
235	2"	$2\frac{3}{4}$ "	2"	6"	30
212-T&G*	2"	$2\frac{1}{2}$ "	$2\frac{1}{2}$ "	6"	24
250**	$2\frac{1}{2}$ "	2"	2"	6"	25
245	$2\frac{1}{2}$ "	$2\frac{1}{8}$ "	2"	6"	25
280	$2\frac{1}{2}$ "	$2\frac{1}{4}$ "	2"	6"	25

Note: *No. 212T&G—Tongue and Groove end brick for 2" lining.

**No. 250 is for lining mill ends and can be installed as a 2" or $2\frac{1}{2}$ " lining.

◀ These special McDaniel mill lining shapes are an overhanging type of frame brick which fully cover the metal door and mill frame. For further information write for catalog.



McDANEL Ceramic

Grinding Balls . . .

PROVIDE FAST, CLEAN GRINDING AT LOW COST . . .

McDaniel Vitreous Porcelain Grinding Balls have passed the test of time and are accepted everywhere as the standard. Made of a specially developed body, they are hand rolled, then carefully fired until fully vitrified and impervious. Slow cooling maintains the uniform particle structure. Test milled and individually inspected before shipment.

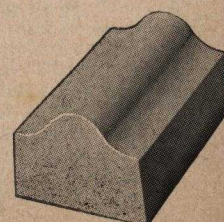
The McDaniel Vitreous Porcelain Ball provides fast, clean grinding at low cost. Trouble free at all times. Any pickup due to wear from these balls is compatible in the batch and fires at normal temperatures for enamels and glazes. Uniform wear, no chipping or spalling.

Cat. Nos. — Porcelain Grinding Balls

PGB3 - 3"	PGB114 - $1\frac{1}{4}$ "
PGB212 - $2\frac{1}{2}$ "	PGB1 - 1"
PGB2 - 2"	PGB34 - $\frac{3}{4}$ "
PGB112 - $1\frac{1}{2}$ "	PGB12 - $\frac{1}{2}$ "

Approximate weight—87 to 91 lbs. per cu. ft.

LIFTER BARS
AVAILABLE IN
HIGH DENSITY
BODY FOR
ALL MILL SIZES.



MATHEWS CONVEYER COMPANY

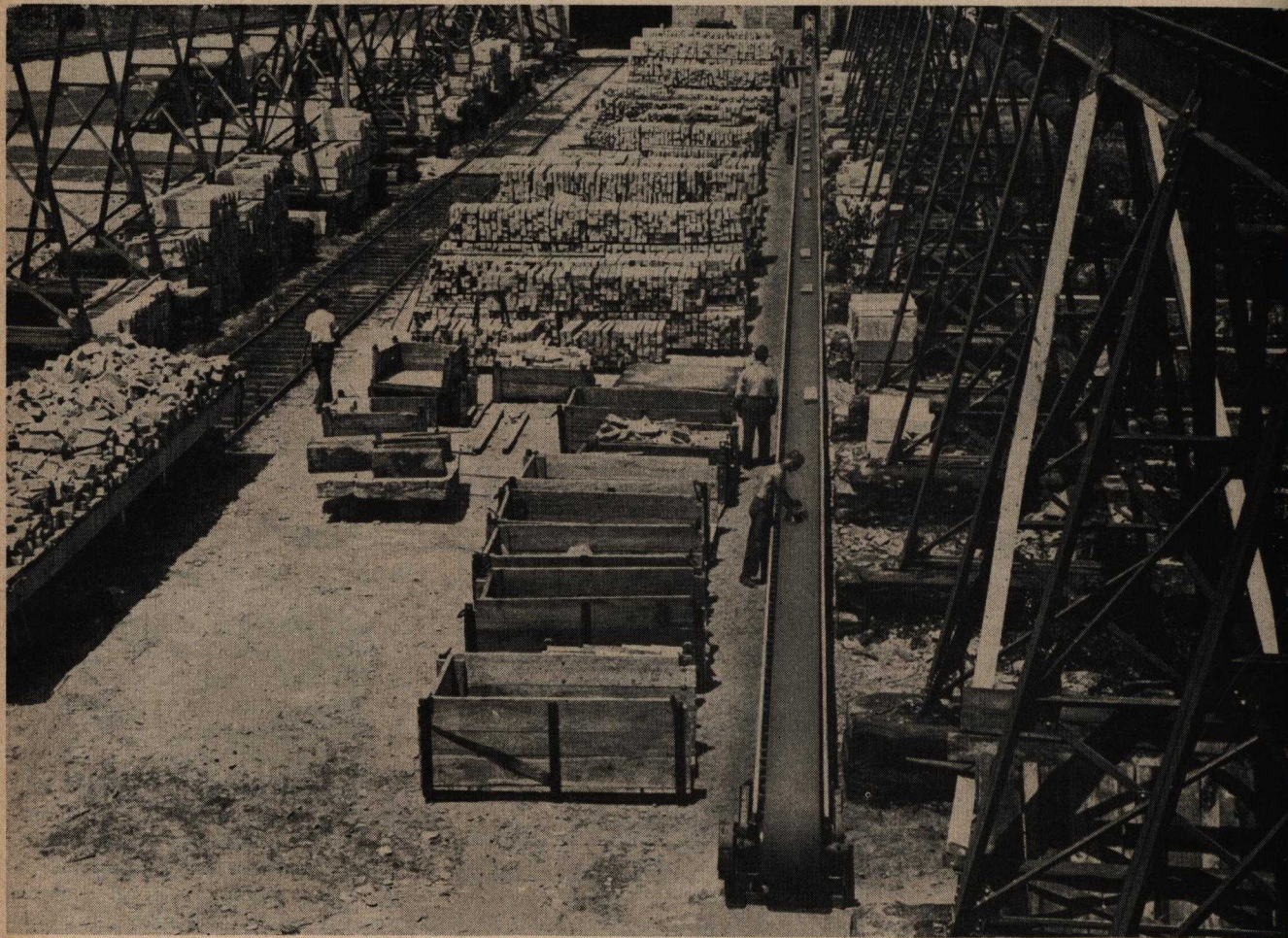
GENERAL OFFICES . . . ELLWOOD CITY, PENNSYLVANIA



PACIFIC COAST DIV., MATHEWS CONVEYER COMPANY WEST COAST,
SAN CARLOS, CALIFORNIA

CANADIAN DIVISION . . . MATHEWS CONVEYER COMPANY, LTD.
PORT HOPE, ONTARIO

Engineering Offices or Sales Agencies in Principal American and Canadian Cities
Export Representative—Foreign Trade Division of New York Hanseatic Corporation



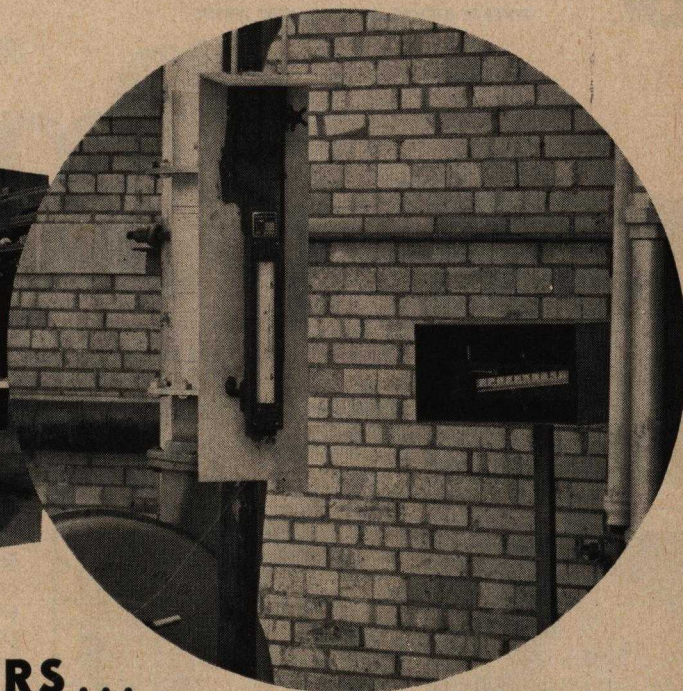
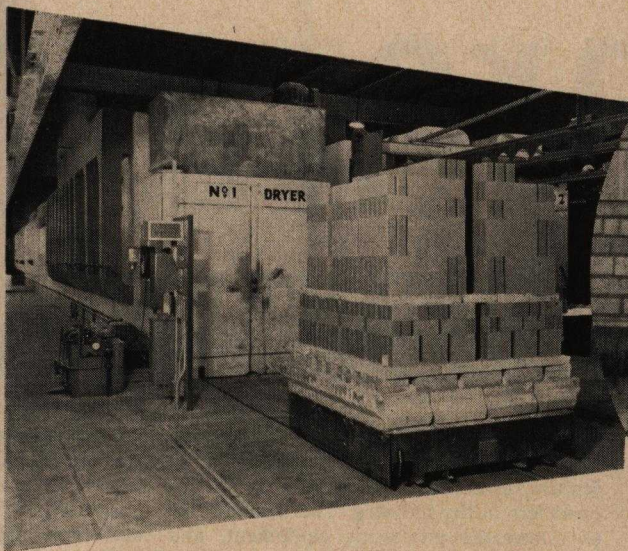
A typical belt conveyor installation for handling stone from plant to yard.

Whatever the product to be handled—stone, brick, building blocks, tile, china ware, or glass products—there are Mathews conveyers to do the job easily and economically. Whether the requirement is for a few sections of roller or wheel conveyor, a portable belt conveyor, or a complete conveyor system, it is a job for Mathews engineers.

MATHEWS

THE MERIAM INSTRUMENT COMPANY

10920 Madison Avenue, Cleveland 11, Ohio



MERIAM MANOMETERS...

Basic Instrumentation for the Ceramic Industry

Meriam manometer instrumentation offers ceramic producers probably the highest return available per investment dollar on existing equipment and the best assurance of maximum performance on new installations. Trends in the industry have put as great an emphasis on temperature *distribution*, as determined by Meriam Draft Gauges, as on temperature itself. Modernization programs, based largely on draft control, have increased kiln productivity as much as 50%. At the same time, substantial upgrading of output as well as fuel reductions up to 10% have been reported.

Considered from the viewpoint of lower reject rates and greater product uniformity alone, Meriam Manometer Instrumentation, offering the highest accuracy at lowest cost, is well worth your immediate investigation.

Shown on this page are representative instruments from the Meriam line covering pressure, vacuum, draft and flow measurement. More detailed literature is available upon request or the local Meriam representative will be glad to review your specific problems with you.

U-TUBE MANOMETERS

Offering maximum simplicity and lowest cost, Meriam No. 10AA25 Manometers are used in large numbers throughout ceramic plants. They require virtually no maintenance yet afford operators a means of checking pressure and draft conditions at any time during firing. This data, readily available, permits accurate draft regulation and pays for itself quickly in reduced culls and greater color uniformity.

Model 10AA25, shown, has maximum working pressure of 250 psi. Models available for pressure, vacuum or differential ranges up to from zero to 24.6 psi. Scale lengths: 6, 10, 15, 20, 24, 30, 36, 50 inches.

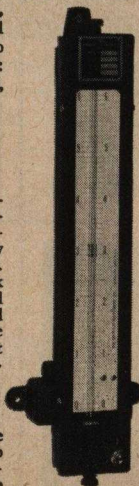


WELL-TYPE MANOMETERS

Meriam Well-Type Manometers are direct reading—no adding of distances above and below the zero line is required.

The straight, heavy walled Pyrex glass indicating tube is gland packed to prevent leakage. On all models, the tube is clamped to the rigid steel channel body to prevent distortion and breakage. A tight-fitting glass cover keeps out dust, assuring clear visibility at all times.

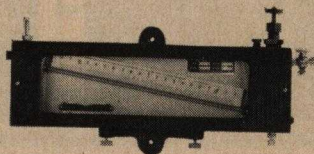
Meriam Model 30EB25 Well-Type Manometer, shown, may be used to measure pressure, vacuum, or differential ranges up to from zero to 63.8 psi. Scale lengths from 6 to 130 inches.



DRAFT GAUGES

Meriam Draft Gauges are standard equipment in ceramic applications for critical pressure, vacuum, and differential measurements especially in the control of combustion. They offer the highly sensitive expanded-scale measurement required for proper control of firing and greatest fuel economy.

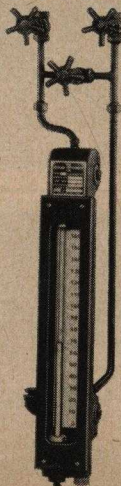
Meriam Model 40GC4, shown, is available in ranges from $\frac{1}{2}$ to 4 inches of water extended over an 11 inch scale. Model 43GC4-2 has two tubes and scales permitting simultaneous reading of two co-ordinated draft measurements on one instrument.



INDICATING FLOWMETERS

While the simplest of all flowmeters, Meriam Flowmeters provide highly accurate and responsive flow indications... with low pressure drop... negligible maintenance, and without the need for calibration at any time. The basic accuracy and simplicity of this instrument makes it ideally suited to ceramic applications where gas or liquid flow indication is desirable.

Model 30HA25, shown, is direct reading with a built in return well which prevents loss of fluid should severe line surges occur. Model 30HA25 is designed for operating pressures up to 250 psi. Other models are available for higher pressures. Complete flowmeter, with bypass piping, precision orifice plate, and orifice flanges may be ordered for quick and simple installation.



ABSOLUTE PRESSURE GAUGES

Meriam Absolute Pressure Gauges are available in U-tube and direct reading well-types. They are self-compensating for changes in barometric pressure. Available for measurement of absolute pressures from 1mm. to 100" mercury absolute. Details upon request.

MERCURY PRESSURE GAUGES

For low pressure ranges, the convenience and utility of Meriam Mercury Pressure Gauges cannot be surpassed. They are direct reading, accurate, compact, non-spilling, and never require calibration. Mercury cannot be lost either through spilling or over-pressure.

Model 36EA2, shown, has three inch scale for standard ranges of 0-40 inches of water or 0-3 inches mercury. Model 36EA4, not shown, has standard duplex scale graduated 0-3 psi and 0-48 ozs. Model 36EA6, not shown, has scale graduated in inches and tenths. Available in 8, 12 or 16 inch range. For wall or panel mounting.



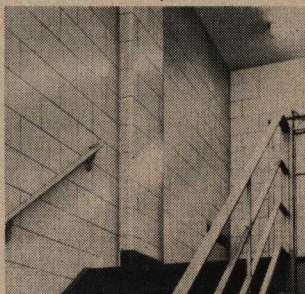
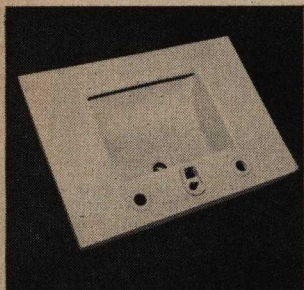


METAL & THERMIT CORPORATION

GENERAL OFFICES: RAHWAY, NEW JERSEY

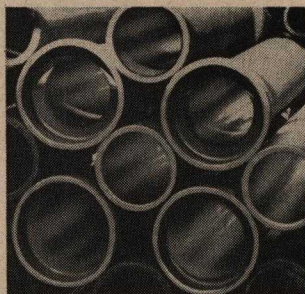
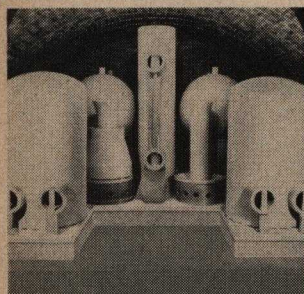
Ceramic

HIGH IN UNIFORMITY, LOW IN COST

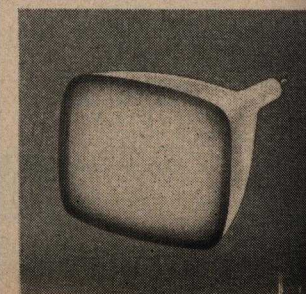
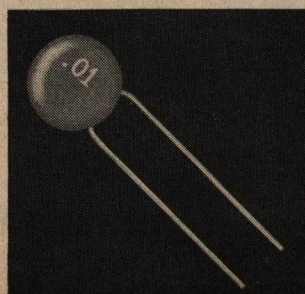
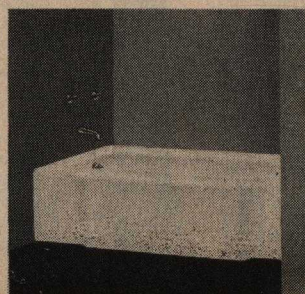
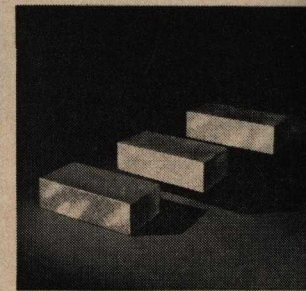
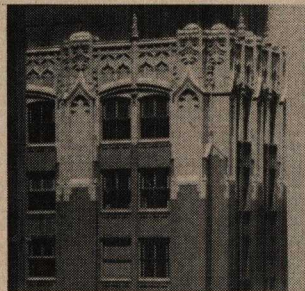


The consistent uniformity of M&T ceramic materials is a result of the same rigid quality standards that have, for almost half a century, established an enviable reputation for M&T ceramic opacifiers in the industry. The demand for high purity, the use of automated processing equipment, and careful control of chemical analysis, assure uniform and predictable results with every batch.

Metal & Thermit research and ceramic service laboratories have pioneered in the development of new and improved enamels and glazes . . . continue to aid in the application of opacifiers, additives and minerals for the ceramic industry. Detailed literature concerning M&T ceramic materials and services are available on request.



For fine quality ceramic materials, look to Metal & Thermit . . . for the greatest economy and satisfaction in their use, depend on Metal & Thermit ceramic service facilities.



materials

OPACIFIERS FOR GLAZES AND ENAMELS

PRODUCT	FORMULA	DESCRIPTION	USE
TIN OXIDE Light	SnO_2	White powder	Ingredient of ceramic color stains for enamels and glazes. Designed especially for reds but also used in grays, greens, and blues. Used as component of ceramic capacitors. Opacifier for white glazes where maximum lustre is desired. Used to provide color stability and opacity in colored glazes. Prime Metal Tin Oxide is produced from pure tin metal specifically for use as component of ceramic color stains, especially yellows and reds. Also used as stabilizer for colors.
Special White	SnO_2	White powder	
Prime Metal	SnO_2	White powder	
ULTROX®	ZrSiO_4	White powder	Opacifier for white and colored glazes for vitreous sanitary ware, wall tile, stone ware, glazed brick, terra cotta.
ULTROX® 500W	ZrSiO_4	White powder	Opacifier for special white and pastel colored glazes.
ANTIMONY OXIDE (Antimony Trioxide) 99.5%	Sb_2O_3	White powder	Used as an opacifier and adherence promoter in enamels. Fining agent and decolorizer for glasses. Especially desirable where solarization effects are to be avoided. Ingredient of yellow ceramic color stains.
SODIUM ANTIMONATE	$\text{Na}_2\text{O} \cdot \text{Sb}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$	White powder	Standard opacifier for all dry-process cast-iron enamels where maximum opacity and uniformity are desired. Also used in enamels for sheet steel. Used as fining agent and decolorizer in glasses, especially those melted in platinum such as optical and ophthalmic types.

ADDITIVES FOR CERAMIC DIELECTRICS

BISMUTH STANNATE	$\text{Bi}_2(\text{SnO}_3)_3 \cdot 5\text{H}_2\text{O}$	Light colored crystalline powder	Component of ceramic capacitors; especially useful with barium titanate to provide capacitors with flatter temperature-coefficient curves. Stannates of Cd, Ca, Co, Cu, Fe, Pb, Li, Mg, Ni, Sr, and Zn also available.
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MINERALS FOR CERAMICS

ILMENITE	FeTiO_3	Black granular mineral	Production of white titanium dioxide used in colored bodies and glazes.
RUTILE	TiO_2	Reddish brown mineral	Production of ceramic colors, titanium metal, arc-welding electrodes.
ZIRCON Granular	ZrSiO_4	White sand	Source of ZrO_2 for glass batches. For use in refractories, special molding sands and fine sand blasting.
Milled		White powder	Ingredient of enamels, electrical porcelains, refractories. Source of ZrO_2 for glass batches.



**METAL & THERMIT
CORPORATION**

Tin, Antimony, and Zirconium chemicals

MINNEAPOLIS-HONEYWELL REGULATOR CO.

Wayne and Windrim Avenue

Industrial Division

Philadelphia 44, Pa.

Wherever ceramics *Brown instruments*

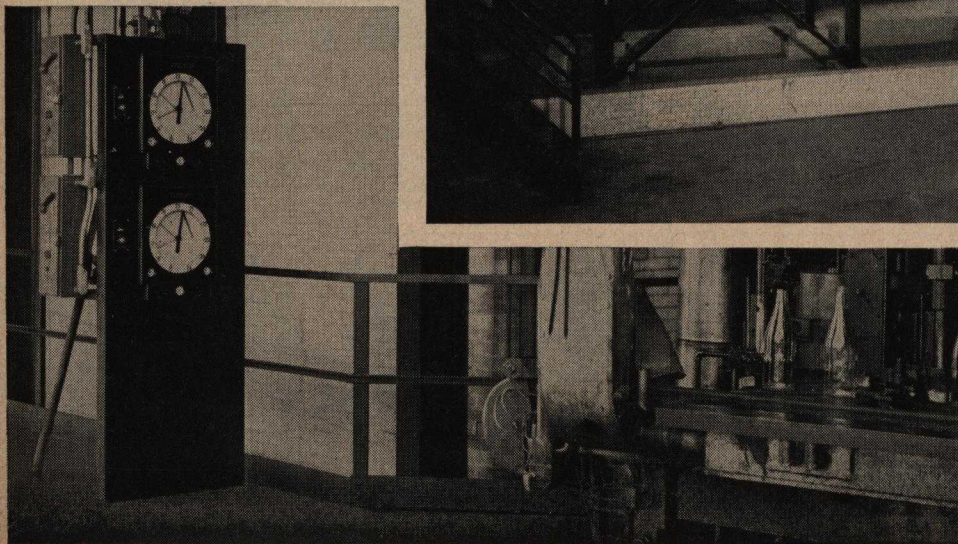
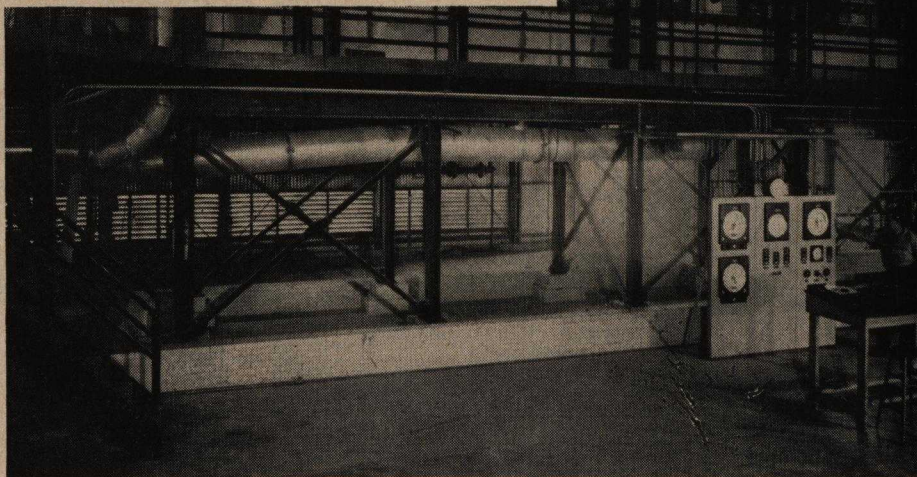


TUNNEL KILN CONTROL

with Brown instruments brings day-to-day benefits to Canadian Porcelain Co., Ltd. in the production of high-voltage insulators.

GLASS PRODUCTION

is substantially increased and quality of ware improved by Brown instrumentation which controls temperatures, level, flow and pressure in glass tanks. Typical installation is this glass tank control panel.



FOREHEARTH CONTROL,

by *ElectroniK* instruments with *Air-O-Line* pneumatic control, holds critical temperatures in spout and feeder within the extremely close limits required to produce highly uniform ware at high production rates. Shown is the control installation at Diamond Glass Co., Royersford, Pa.

are made aid production

BROWN instruments are put on the tough jobs throughout the ceramics industry. But they can take it. Their proved ability to deliver accurate, sensitive and dependable performance has made them the leading choice for measurement and control in the manufacture of

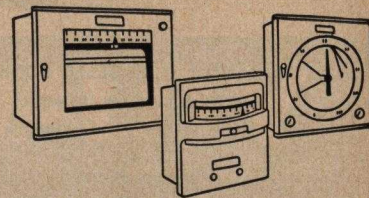
- Glass
- Heavy clay products
- Vitreous enamel
- Pottery
- Electronic components
- All other ceramic goods

To put these instruments to work effectively on your own production equipment, Honeywell offers the services of its *Application Engineering Staff*. This group of specialists knows the ceramics industry through years of first-hand experience. Whether your application requires a single instrument, or large, integrated system, these engineers will design instrumentation that will help you increase production at less cost.

Your local Honeywell engineer will be glad to study your specific process and show you how these versatile instruments can aid your production. Call him today . . . he's as near as your telephone.

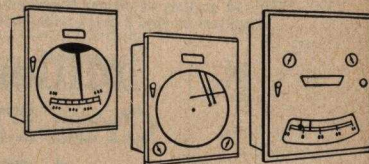
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Composite Catalog No. 5002 for a condensed listing of the complete Honeywell industrial line . . . and ask for Data Sheets on specific applications.



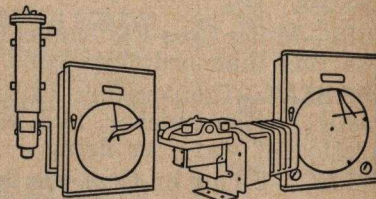
TEMPERATURE INSTRUMENTATION

includes *ElectroniK* Potentiometers in strip chart, circular chart, circular scale and multi-point indicating models; with a variety of electric and pneumatic control systems; single and multi-pen thermometers; *Radiomatic* radiation-type pyrometers; *Pyr-O-Vane* millivoltmeter instruments; and a complete line of pyrometer supplies.



PRESSURE INSTRUMENTATION

includes indicating, recording and controlling instruments in ranges extending from absolute zero to thousands of pounds per square inch . . . also the Brown Furnace Pressure Controller, for sensitive, accurate actuation of dampers to hold either positive or negative pressure within furnace chambers and kilns.



FLOW INSTRUMENTATION

covers a full line of flow meters and flow controllers, including square root scale and evenly graduated types, with advanced electronic integration and with a variety of meter bodies for all types of fluids, pressures and ranges . . . Fuel-Air Ratio controllers . . . and a complete line of diaphragm motor control valves.

Honeywell



First in Controls

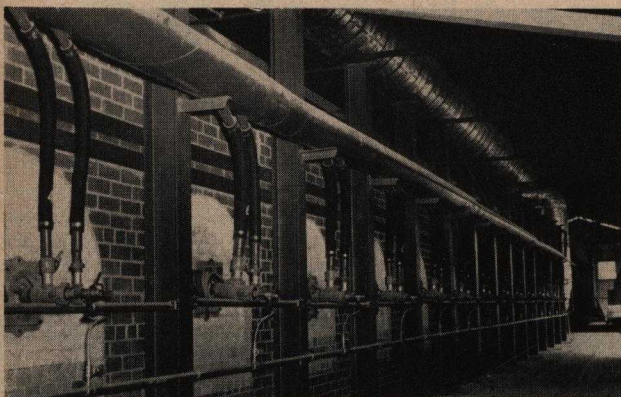
MILLER EQUIPMENT CO.

Pacific Agent:

WALTER C. STOLL & SONS
5028 Alhambra Avenue
Los Angeles 32, California

Southwestern Agent:

A. K. MOULTON ASSOCIATES
Plaza Professional Building
6936 San Pedro Avenue
San Antonio 12, Texas



Only 38 gallons of oil per thousand brick feeds all these burners in this 8 brick wide Miller Cros-Flo Kiln.

Miller Cros-Flo Tunnel Kilns

The Miller Cros-Flo Tunnel Kiln successfully provides even circulation throughout the settings of ware in the kiln. Built-in baffles and fans, staggered throughout, force air and gases to criss-cross the kiln.

HUMIDITY—Miller Cros-Flo provides control of air movements and humidity from drier through the cooling end.

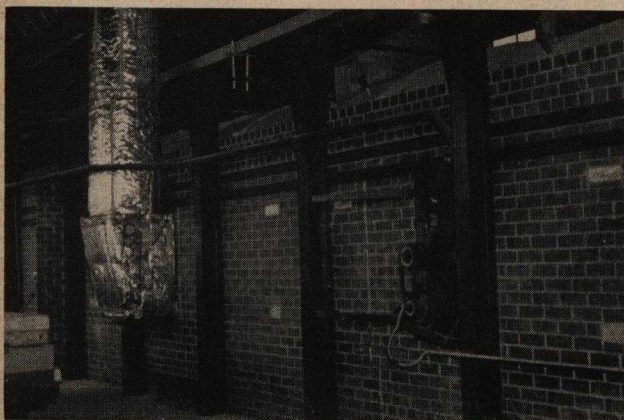
PRODUCTION—Miller Cros-Flo involves less handling of ware, faster uninterrupted production process.

FUEL—Miller Cros-Flo Tunnel Kilns consume much less fuel than ordinary kilns.

PRE-HEAT—Temperature raised to desired point easily, giving quicker, and more thorough preparation of ware for firing.

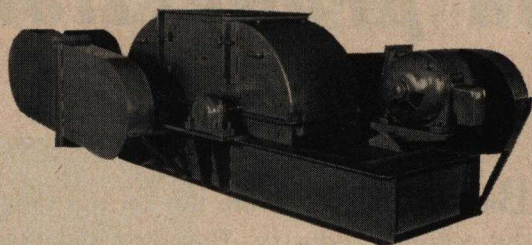
FIRING—Firing by Cros-Flo is developed by staggered arrangement of burners, assuring uniform heating.

COOLING—Miller Cros-Flo Cooling Sections circulate hot and cold air independently.



Partial view of cooling end of Miller Cros-Flo Kiln. Cros-Flo fan and insulated ducts make possible controlled cooling.

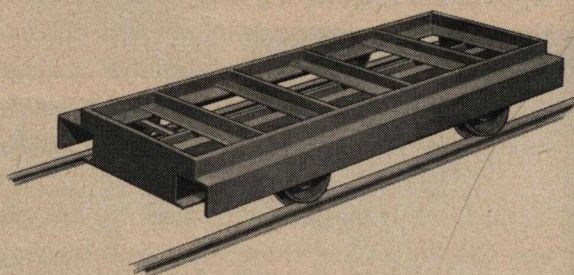
Miller Double Rotor "Bonus" Hammermills



Miller Model 4 Hammermill, with 50 HP motors at each end. This model grinds up to 100 tons per hour of minus-8 mesh.

Miller "Bonus" action double rotor Hammermills give added hammering, on same horsepower, with less wear on hammers. Rotors revolve toward each other, throwing particles of material together in collision. Material actually helps to pulverize itself. As a result you get better prepared material, ample capacity, and greater percentage of fines.

MILLER HAMMERMILLS are ruggedly built and precision machined to close tolerances. Hammers and screen gates are high grade cast Manganese Steel. Hammers and tips are replaceable, thus reducing maintenance costs.



Miller "Touch And Go Roll" Kiln Cars

Miller Engineers design kiln cars that roll free and easy. Equipped with Timken Tapered Roller Bearings, 2 units per wheel, a fully loaded Miller car is easily moved by one man.

You get years of smooth, anti-friction performance with a minimum of maintenance. Miller can design and build a kiln car for any type kiln.

Miller
Equipment
Company

CROS-FLO TUNNEL KILNS,
HAMMERMILLS, KILN CARS,
CONVEYOR EQUIPMENT,
ENGINEERING SERVICE

P. O. Box 1566

Phone ME 3-3541

Salisbury, N. C.

MILLER FLUID POWER DIVISION

Flick-Reedy Corp.

2002-08 NORTH HAWTHORNE AVENUE, MELROSE PARK, ILL.

YEARS-AHEAD QUALITY at no extra cost 1½" THROUGH 20" BORES • 250 P.S.I. NON-ROTATING AIR CYLINDERS



WITH STANDARD QUALITY FEATURES FOUND In No Other Air Cylinder

CASE-HARDENED CHROME-PLATED PISTON RODS

Provide best known protection against rod damage and rust.

ROD BUSHING SEAL

Prevents air leakage past piston rod bushing. Guaranteed extrusion-proof, shear-proof

"SHEP" TUBING END SEALS

Exclusive Miller design (pat. applied for). Teflon sealing ring with zero clearance metal backup forms Shearproof, Heatproof, Extrusionproof, Fluidproof (SHEP) seal that guarantees leakproof sealing at all pressures and shock loads.

TEFLON* WIPERS

Teflon Rod Wipers seal out dirt and abrasives, withstand -100° F. to plus 450° F. temperatures, and are impervious to practically all known gases, fluids, chemicals.

RUST-RESISTANT SURFACES

Rust-Resistant Coating provides extra protection during shipment, storage, installation, and operation of air cylinders. Heads, caps, mountings, pistons followers, and the unplated portions of piston rods have this finish.

OTHER FEATURES STANDARD ON ALL MILLER AIR CYLINDERS

- Unbreakable Solid Steel Heads, Caps and Mountings
- Precision-Honed, Rustproof, Non-Corrosive, Brass Tubing that minimizes friction and wear.
- Self-Regulating, Wear-Compensating Piston Rod Flange Seal. Leakproof and tamperproof — never requires adjustment.
- Space-Saving "Square" Design — and other features as shown in Bulletin A-105 Sent FREE On Request

*Dupont trademark for its tetrafluoroethylene resin

LOCK-SEAL CUSHION ADJUSTING SCREW

Non-protruding — permits mounting cylinders on any side. Is self-regulating, self-locking, Teflon-sealed, and interchangeable with Teflon-sealed ball check for easy access.

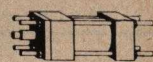
MOST COMPLETE LINE EVER OFFERED

Choose from 19 standard models in bore sizes that provide any desired thrust up to 39 tons plus. Any desired stroke up to 22 ft. Millions of strokes per cylinder proven in heaviest duty service. Fully meet J. I. C. Standards. Available in single and double rod end, cushioned and non-cushioned, oversize rod, other types.

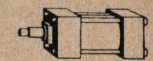
IMMEDIATE DELIVERY

Over 4,600 different air cylinder selections—from 1½" through 8" bores, in 1" through 36" strokes, in 17 popular mountings—are available from stock for immediate shipment on order. Write for complete Stock List.

See other Miller products under headings: Cylinders, Hydraulic; Boosters, Air-Hydraulic; Accumulators



TIE ROD MOUNTING
—HEAD OR CAP END



SQUARE MOUNTING
—HEAD END



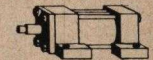
SQUARE MOUNTING
—CAP END



FLANGE MOUNTING
—CAP END



FLANGE MOUNTING
—HEAD END



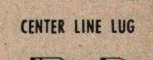
SIDE LUG



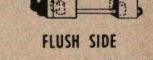
END LUG



CENTER LINE LUG



FLUSH SIDE



TRUNNION—CAP END



TRUNNION—HEAD END



INTERMEDIATE TRUNNION



FIXED CLEVIS



DETACHABLE CLEVIS



MILLER FLUID POWER

DIVISION OF FLICK-REEDY CORPORATION

Sales and Service from Coast to Coast

2002-08 NORTH HAWTHORNE AVE., MELROSE PARK, ILL.

MILLER POTTERY ENGINEERING CO.

Designers and Manufacturers of Ceramic Machinery

2300 PALMER STREET

• SWISSVALE, PITTSBURGH 18, PA., U.S.A.

Cable Address "Ceramic" Pittsburgh

DECORATING MACHINERY

TYPE 9—6 HEAD GOLD EDGE LINING MACHINE for diversified ware decoration.

200 Dz./Hr.

TYPE 21—SINGLE HEAD GOLD EDGE LINING MACHINE for flatware or tumblers.

75 Dz./Hr.

TYPE 12—SELF-POWERED GOLD LINE APPLICATOR for specialty shapes.

TYPE 21-T—SINGLE HEAD GOLD BANDING AND EDGELINING MACHINE for tumblers or goblets.

75 Dz./Hr.

TYPE 17—SINGLE HEAD STAMPING MACHINE for gold or color on round dinnerware.

TYPE 22—SINGLE HEAD GOLD FACE LINE OR EDGE LINE MACHINE for flatware.

80 Dz./Hr.

TYPE 269—3 HEAD GOLD STAMPING MACHINE for flatware with automatic take-off.

175 Dz./Hr.

TYPE 51—2 HEAD GOLD BANDING MACHINE for tumblers or cylinders.

150 Dz./Hr.

POTTERY MACHINERY

TYPE 7—2 HEAD JIGGER SYSTEM with automatic stripping, finishing and stacking onto conveyor.

150-180 Dz./Hr.

TYPE 7 AC—2 HEAD CUP JIGGER SYSTEM with automatic stripping, topping and handle sticking.

180 Dz./Hr.

TYPE 8—8 HEAD JIGGER SYSTEM with automatic stripping, finishing, and stacking onto kiln conveyor.

640 Dz./Hr.

TYPE 70—SINGLE HEAD AUTOMATIC JIGGER MACHINE SYSTEM for flat or hollowware.

90-110 Dz./Hr.

TYPE 11 MD—TWO HEAD SEMI-AUTOMATIC JIGGER MACHINE with automatic feed.

160-180 Dz./Hr.

TYPE 15 MB—2 HEAD WARE DRESSING MACHINE with automatic feeding and re-stacking onto conveyor.

300 Dz./Hr.

TYPE 3—TWO HEAD CUP JIGGER suitable for short runs with full automatic operation by foot control.

100 Dz./Hr.

TYPE 40-SA—HANDLE STICKING MACHINE with full automatic handle trimming, slip application, and cup topping.

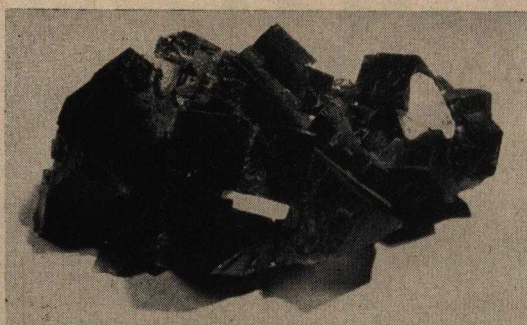
200 Dz./Hr.

CUSTOM BUILT MACHINE SYSTEMS FOR SPECIAL PURPOSES (brushing, glazing, casting, grinding, etc.) **DESIGNED WITH INTEGRATED CONVEYORS AND WARE TRANSFERS FOR COMPLETELY AUTOMATED OPERATION.**

Additional information regarding the items listed will be sent upon request. Discussions with us regarding our products entail no obligation.

MINERVA OIL COMPANY

FLUORSPAR DIVISION — ELDORADO, ILL.



THIS IS A CRYSTAL OF FLUORSPAR " calcium fluoride, the only common fluoride-bearing mineral, is found in veins and bedded deposits near old volcanic areas such as are in Hardin County, Illinois. This area has been the source of most of the ceramic and acid grade fluorspar used in the U.S. for nearly 100 years, and known reserves are still larger than at any time before."

Largest Producers of CERAMIC FLUORSPARS

- 1,000 tons crude daily milling capacity from two modern mills.
- 20 years' ore reserves in Hardin County, Illinois, alone.

MINERVA FLUORITE

has been supplied by Minerva Oil Co. to the largest and most exacting glass and enamel manufacturers in the nation for over 14 years.

SPECIFICATIONS OF GRADES USED BY CERAMIC CONSUMERS

Grades of Minerva Fluorite	Average chemical analysis						Screen analysis
	CaF ₂	SiO ₂	CaCO ₃	BaSO ₄	Fe ₂ O ₃	R ₂ O ₃	
Acid (97.0% min.)	97.5	.90	.90	.25	.06	.15	65%—200
No. 1 Ceramic (95.0% min.)	95.9	2.3	1.7	.30	.12	.15	72%—200
"Special" (92½-94%)	93.5	2.9	2.5	.50	.17	.43	85%—200
No. 2 Ceramic (85% min.)	88.5	5.5	4.6	.75	.24	.64	85%—200

- No. 1 Ceramic Grade is available as WETTABLE fine ground concentrate for use in Pottery Glazes and other applications where water-mixing is necessary.
- SUPERFINE grind (95% through 325 mesh screen) is available in #1 ceramic grade, where best adapted for use in very light-colored brick, welding rod coatings and glaze extenders.

Attention: Buff Brick Makers

- GREEN SCUM on BUFF FACE BRICK is eliminated by the addition of small amounts to counteract vanadium salts present in the clay or shale. MINERVA FLUORITE vitrifies the interior of the brick at low temperatures and prevents vanadium efflorescence.

MINERVA FLUORITE is supplied in bulk, in either paper-lined box cars or covered hoppers, and in 100 lb., 4-ply paper bags. We palletize and unitize bagged shipments to your specifications. Shipments made FOB Rosiclare or Junction, Illinois, by carload, LCL or motor freight.

USES: Fluorspar is included in ceramic batch formulae

for its outstanding properties as a natural flux, conditioner, opacifier and decolorizer. The addition of small quantities of fluorspar gives smoother finishes where used in glazes, extends the working range and promotes more rapid fusion of any glass, glaze or frit.

WE INVITE inquiries about special uses and applications.

FOR FURTHER INFORMATION, PRICES, SAMPLES OR TECHNICAL ASSISTANCE WRITE

MINERVA OIL CO. — — — ELDORADO, ILLINOIS

Or Our Sales Agents

Hickman, Williams & Company

(INCORPORATED)

PITTSBURGH • CHICAGO • NEW YORK • ST. LOUIS • DETROIT • CINCINNATI • PHILADELPHIA • CLEVELAND

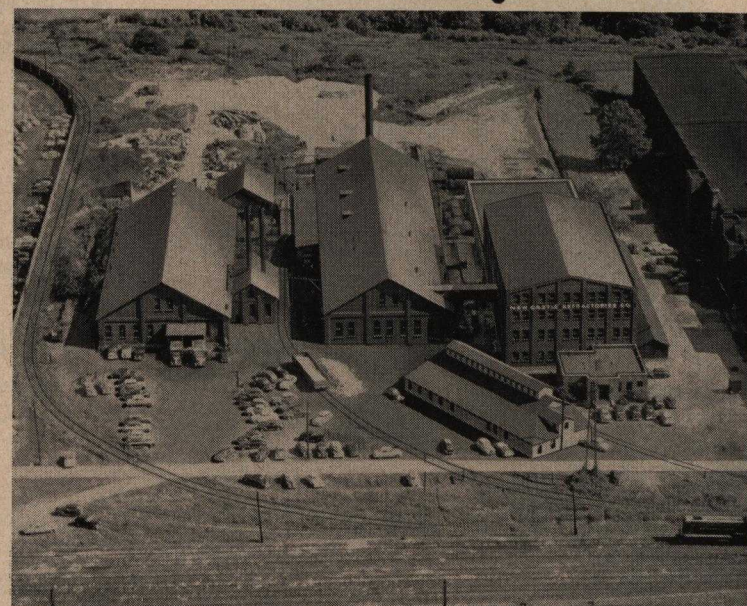
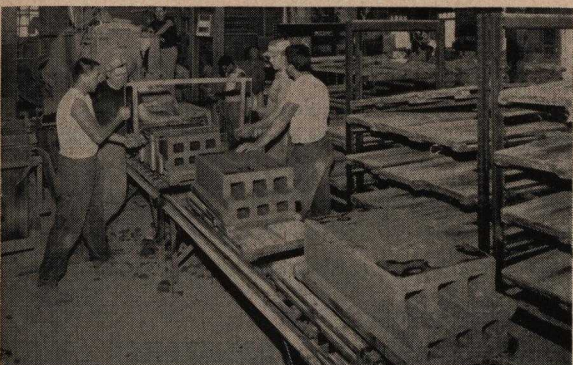
New Castle Refractories



A small section of one of the New Castle plant Casting shops. Note the battery of humidity controlled dryers insuring uniform drying of pieces ranging in size from small setters to slabs and varied shapes up to 500 pounds.



Workmen are shown finishing products to insure perfect fit. Complete grinding facilities are available for finishing, cutting and surfacing all type refractory materials.



An aerial view of the New Castle plant and home offices at New Castle, Pa. The capacity of this plant is devoted entirely to the manufacture of kiln furniture and special shapes fabricated from silicon carbide, sillimanite mullite and high quality fire clays.

Complete facilities for forming by casting, pressing, extruding and air ramming permit for forming of all type shapes and sizes of products.

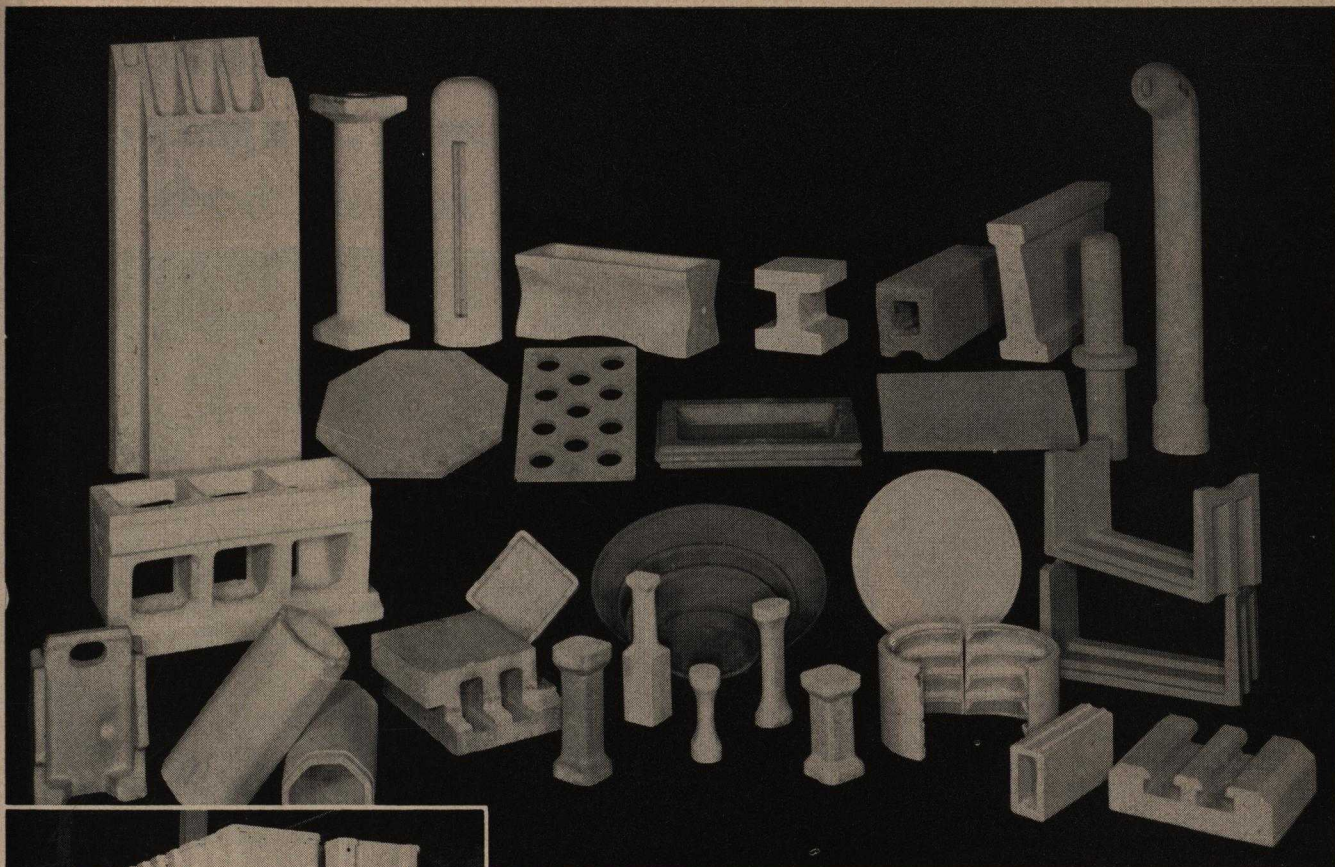
A complete line of slabs, car block, posts, girders, muffles, lehr tile, recuperator tubes, dish setters, cements and special shapes fabricated to individual specifications make this plant one of the most complete custom shops in the country.

Due to the diversity of products, as well as composition, firing at this plant is done in periodic kilns, a battery of which insure uniform firing at temperatures ranging from 12 to 28 cone.

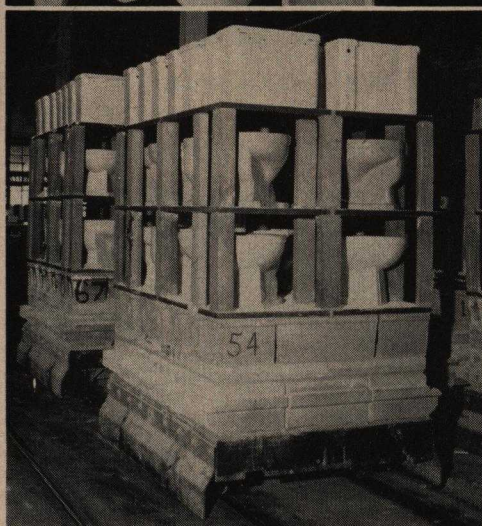
A view of one of the de-aired pug mills used for forming patented hollow car blocks and tunnel kiln muffles. As a complement to this equipment there is a battery of humidity dryers to permit for uniform overnight drying.



***Diversification and Completeness of Line
Gives New Castle Refractories Leadership
in Many Phases of the Ceramic Industry***

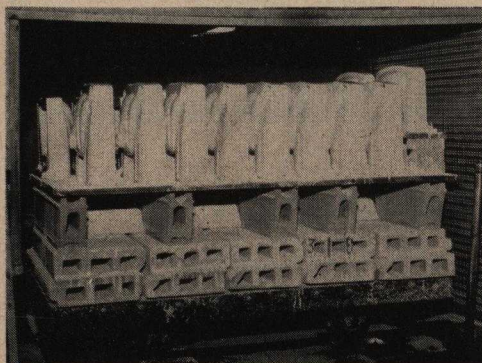


Shown above are a representative few of the diversity of products produced at the New Castle plant. These include Chambers and Chamber Bottoms, Recuperator Tubes, Bowl and Tank Supports, Gas Burners, Dish Setters, Girders, Posts and many other specialties.

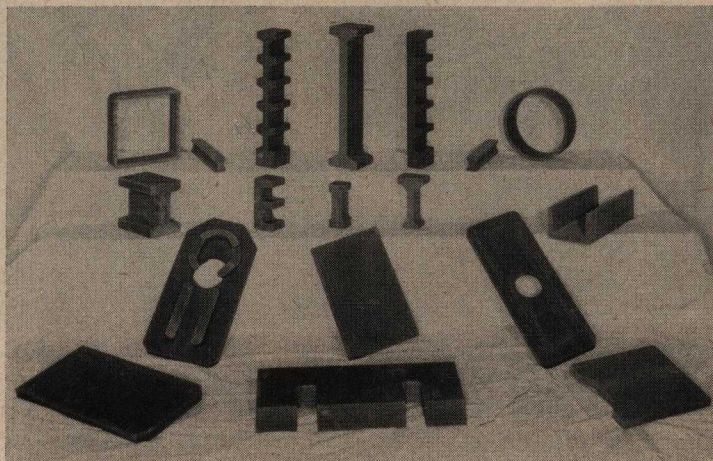


Top is a triple deck Sanitary kiln car in one of the many sanitary plants served throughout the Western hemisphere. Note the use of hollow car tops and girders to permit for more rapid heating and cooling.

Silicon carbide deck slabs supported by cast semi-carbo posts are used throughout the entire car train and car design is diversified to permit for the maximum capacity.



This picture more clearly shows the design of the hollow car block and girders.



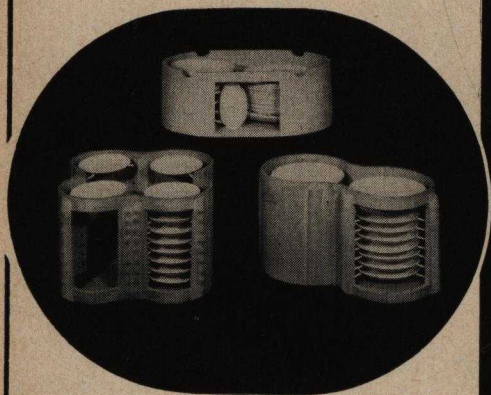
Above are representative products fabricated from Silicon Carbide. Included are various type Posts, Rings, Slabs and other special shapes. These are a few of many hundreds of varied shaped products produced at the New Castle plant.

*Individual Service By
Experienced Personnel*



REFRACTORIES

Newell Plant Produces Finest Quality Bisque and Glost Setters and Saggers By Both Pressing and Casting Methods



Oval shows cutaways of bisque and glost Dinnerware Saggers made by both cast and pressed methods. New Castle specializes in meeting individual requirements in the Kiln Furniture field.

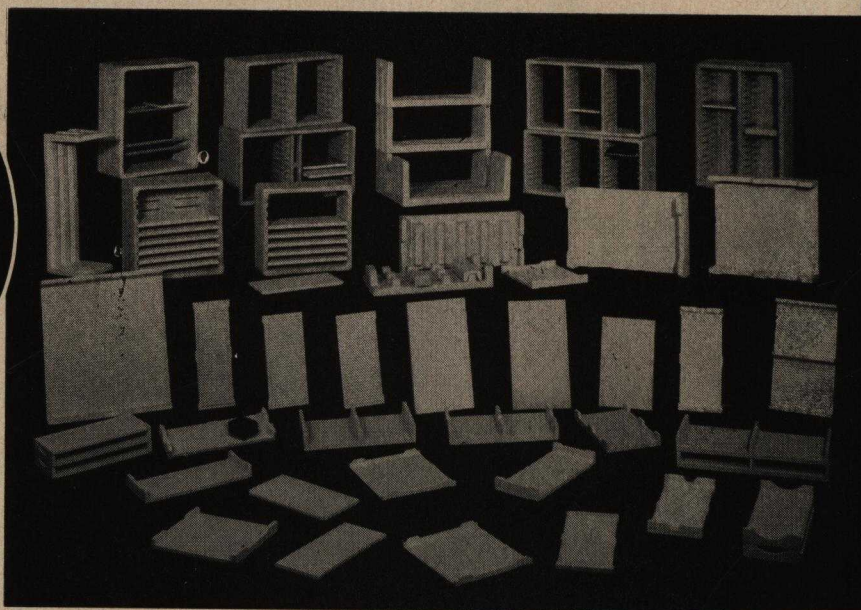
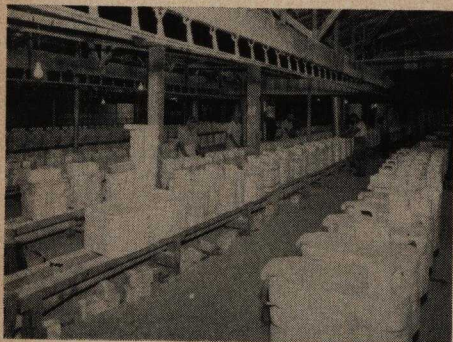
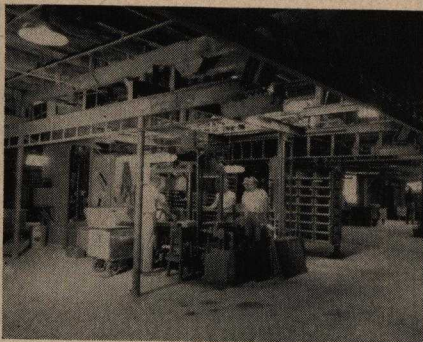


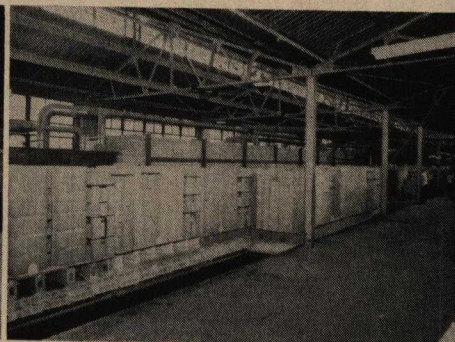
Photo above depicts completeness of New Castle line of Tile Setters. Top row shows bisque and glost refractories for twice-firing. Lower pieces are for once-fired process.



The Newell plant features the most modern facilities in the Ceramic industry. Above is shown a small portion of the Casting Shop where exemplary products begin to take shape.



A section of the Pressing Shop portrays modern press equipment. Presses in foreground are used in making Tile Setters for once-fired process; those in background are heavy-duty type for large shapes.

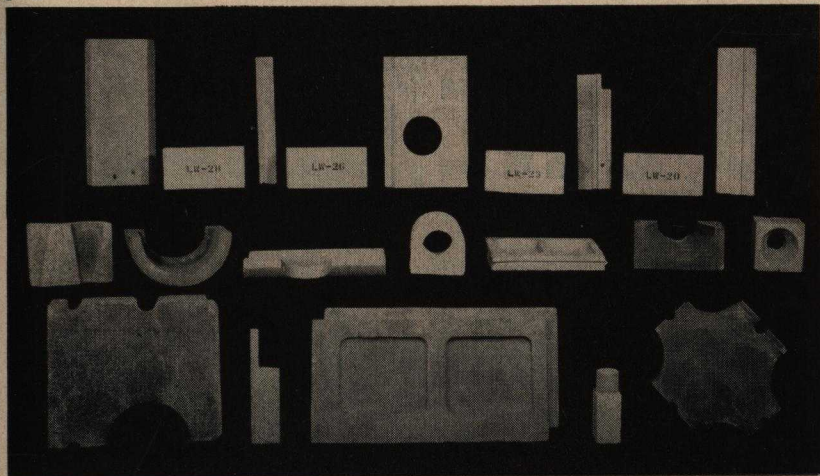


One of two modern tunnel kilns at the Newell plant. Firing is automatically controlled to assure uniformity of products which is vitally important in the special type bodies used in the Pottery industry.

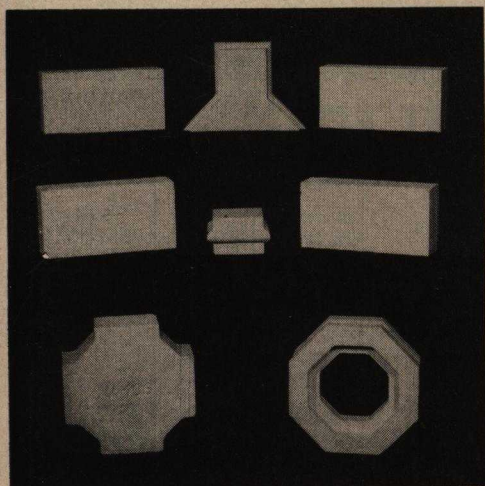


**Most Dependable Name
in the
Refractories Industry**

Almost Endless Line of Special Shapes, Specialties, Insulating and Fire Brick Shapes Produced at Massillon and Zoar Plants



Representative products of the Massillon plant are shown above. These include intricate Special Shapes machined to blue print sizes; machine pressed special shapes in Insulating Fire Brick Bodies; hand moulded Special Shapes furnished in high heat duty, super duty and special duty refractory bodies and various 9" straight series of Insulating Fire Brick with temperature ranges from 2,000 to 2,800 degrees. On all special shape work the various sizes and designs are practically limitless.



Representative products of the Zoar plant include both low and high Heat Duty Fire Brick, Super Duty as well as Special Super Duty Fire Brick and intricate machine-made Special Shapes in various Fire brick bodies. Other products manufactured at Zoar but not shown include Moderate Heat Duty Fire Brick, Intermediate Heat Duty Fire Brick, Super Duty (Fine) Fire Brick, Shapes for Special Applications and Fire Clays.

An almost endless line of Special Shapes, Refractory Specialties, Insulating and Fire Brick for the Glass, Steel, Enamel, Foundry, Domestic Furnace and many miscellaneous industries are produced at New Castle's Massillon and Zoar, Ohio, plants.

At Massillon, production is devoted primarily to the finest quality insulating Fire Brick, Special Shapes and Refractory Specialties. A complete line of Cements, Plastics, Ramming Mixtures, Castables and Aggregates are also produced at this plant.

The Zoar plant specializes in Fire Brick, Special Shapes and Fire Clays. Both plants are well equipped to fabricate materials by either casting, hand moulding, extrusion or machine processing and pieces range in weight from a few ounces to several hundred pounds.

Drying is done in automatic dryers and firing in both tunnel and periodic kilns, insuring uniformity throughout the entire production cycle.

**Individual Attention By
Experienced Personnel**



Plants located at . . .

**New Castle, Pa. • New Galilee, Pa.
Massillon, Ohio • Zoar, Ohio
Newell, West Virginia**

THE NEW JERSEY ZINC COMPANY

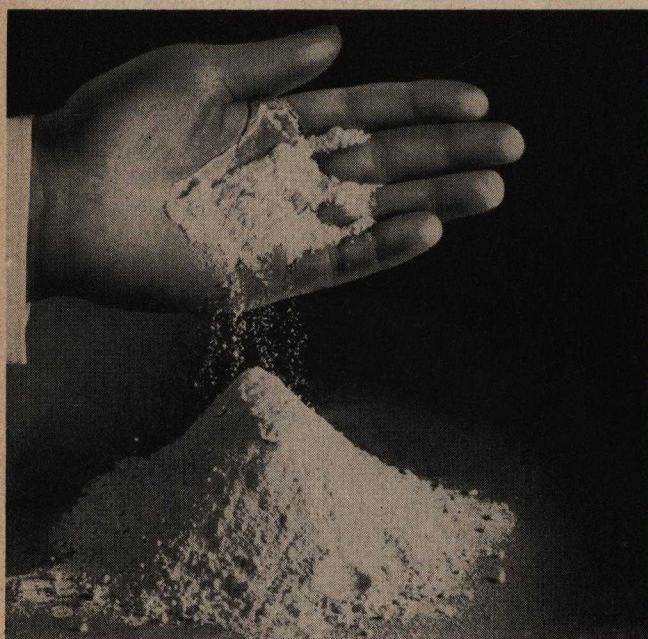
Founded 1848

160 Front Street, New York 38, N. Y.

BOSTON 11, MASS. CHICAGO 1, ILL. CLEVELAND 14, OHIO OAKLAND 4, CALIF. LOS ANGELES 58, CALIF.
137 Kneeland Street 221 North LaSalle Street National City Bank Bldg. 95 Market Street 4560 East 50th St.



HORSE HEAD[®] ZINC OXIDES THE WIDEST VARIETY FOR CERAMICS



IN BOTH POWDER AND PELLET FORM

In addition to pelleting for easier handling, reduced storage space, and cutting dust losses, Horse Head Zinc Oxides are available in a wide variety of physical and chemical properties.

Bulking, for instance, ranges from 51 to 88 pounds per cubic foot.

Water absorption varies from 30 to 102 cc per 30 grams of material.

Unit loads of Horse Head Zinc Oxide for fork-truck handling are available on request. Carload shipments in bulk or in bags are made direct from our smelter at Palmerton, Pa. Less carload shipments are available from any of our several warehouses.

FEATURE	BRAND	DRY BULKING* (Lbs. per cu. ft.)	WATER ABSORPTION* (cc/30-gm.)	GLAZE CONSISTENCY**
ALL-PURPOSE <i>Maximum flexibility for general use</i>	[®] XX-2	53	71	Very heavy
DENSIFIED BY PELLETING 1. Cuts storage space 2. Flows freely from bins & scoops 3. Lowers loss by dusting	XX-32	85	38	Very heavy
DENSIFIED BY REHEATING <i>Medium glaze consistency</i>	XX-503	84	43	Medium
DENSIFIED BY REHEATING <i>Thinnest glaze consistency</i>	XX-504	88	30	Thin
BEST PURITY AND COLOR <i>Highest quality; French Process oxide</i>	[®] FLORENCE RED SEAL-9	51	102	Heavy

* Typical figures.

** Determined on aged slip composition in which only the zinc oxide was varied from test to test.

NICHOLS ENGINEERING & RESEARCH CORP.

NERCO-NIRO SPRAY DRYER DIVISION
70 PINE STREET, NEW YORK 5, N. Y.

Branch Offices: SAN FRANCISCO • INDIANAPOLIS • MONTREAL

4

POINTED QUESTIONS FOR

THE CERAMIC INDUSTRY

HOW

TO

HANDLE

abrasive
ceramic
slips

NERCO-NIRO Spray Drying with the patented and proved abrasion-resistant NERCO-NIRO atomizer wheel assures the economical, trouble-free drying of abrasive slips.

NERCO-NIRO's combination of uniform atomization and "Gentle-ized" drying produces a product with superior uniformity of quality and particle size.

The NERCO-NIRO "Gentle-ized" drying system with low-temperature product exposure at high-temperature drying guarantees a high thermal efficiency without damage to heat-sensitive components of the slip.

The simplified, continuous processing by NERCO-NIRO Spray Drying permits complete, modern automation with corresponding savings in labor and processing costs.

PRODUCE

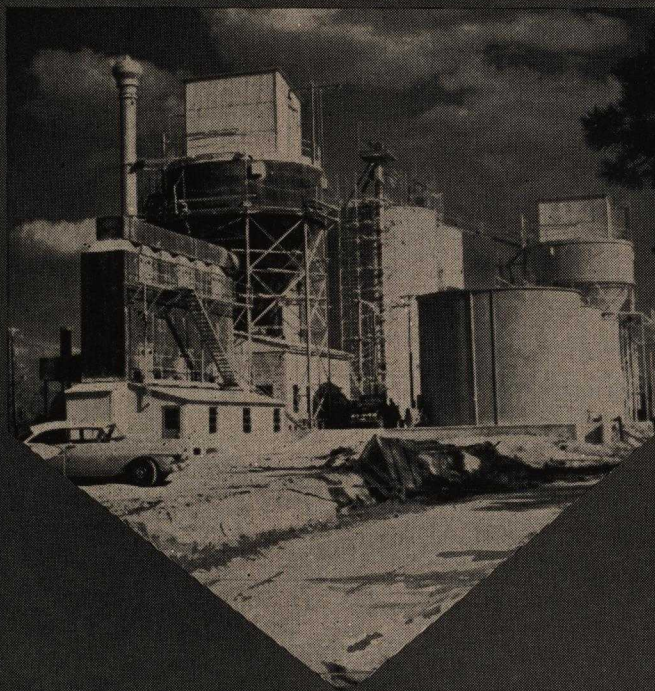
superior
uniform
product

AVOID

damage to
heat-sensitive
binders

OBTAIN

automatic
fool-proof
processing



THE

ANSWER

NERCO-NIRO GENTLE-IZED

SPRAY DRYING

Consult with the NERCO-NIRO
Spray Drying Engineers and discover
how to put more profit in
your ceramic production.



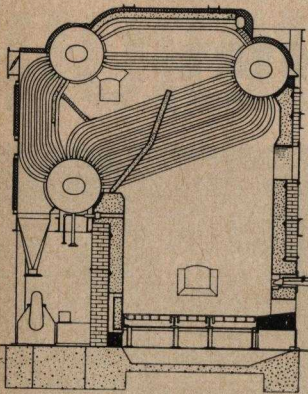
NORTH STATE PYROPHYLLITE COMPANY, INC.

Greensboro, North Carolina
Telephone BR 4-7055 or BR 2-7763

REFRACTORY

PACO

PRODUCTS



Plastic One-Piece Furnace Lining

For original installations or repairs. Made from the mineral pyrophyllite in three grades. Material does not soften below rated fusion point. Forms a solid, joint-free monolithic lining that prevents spalling, gas and heat leakage. Quickly applied; can be fired immediately.

Test	Plastic High Heat Duty	Plastic Super Duty 33-34	Plastic Super Duty 34-35
P.C.E.	cone 29-31 (3040 deg. F.)	cone 33-34 (3185 deg. F.)	cone 34-35 (3225 deg. F.)
Water content	9.2%	9.97%	10.0%
Drying & Firing change			
Drying change (ave.)	-1.7%	-1.46%	-2.0%
Firing change (ave.)	+0.6%	+0.51%	+0.8%
Combined D. & F. (ave.)...	-1.0%	-0.95%	-1.1%
Panel Spalling test, 2910 deg. F. preheat (ave.) ...	3.1%	1.1%	1.1%
Workability index	33.2%	23.1%	23.1%
Hot load test deformation, 2460 deg. F., dried @ 225 deg. F.	1.7%		
Hot load test deformation @ 2640 deg. F. preheat			
@ 2500 deg. F.	0.05%	0.4%	0.7%

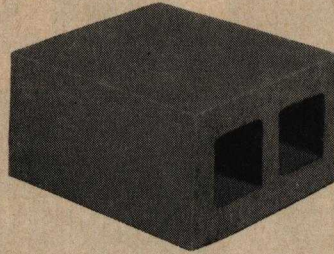
PACOCAST CASTABLE REFRACTORY CEMENT

Can be mixed with water and poured into forms, just like concrete. Sets up in a hard, solid mass in a few hours, and then cured out for use in the furnace. Ideal for special shapes. Economical in lining irregular furnace dimensions, and for patching or casting special shapes in a hurry. Eliminates expensive kiln fired shapes. Has negligible shrinkage; low coefficient of thermal expansion; resists spalling and abrasion. Packed in 100-lb. bags.

Maximum service temp.	2700 deg. F.
Amt. required per cu. ft.	110 lb.
Wt. per cu. ft. in place, poured	128 lb.
Fired to 1500 deg. F.	108 lb.
Allowance req. for expansion from unburned state to max. service temp.	0.3%
Modulus of Rupture (lb./sq. in.)	
Cured and Dried @ 220 deg. F.	420
Fired to 2200 deg. F.	255

OTHER PACO PRODUCTS INCLUDE: • Paco Fire Brick Mortar • Paco Side Car Brick • Paco Ladle Lining • Paco Heatzone Compound

PACO CAR TOPS

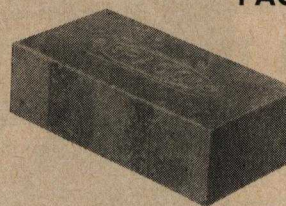


Made from the mineral pyrophyllite, which permits the manufacture of thinner wall, larger core car top that is lightweight, stronger and highly resistant to extreme thermal shock. Paco car tops do not soften below actual fusion point; provide greater resistance to hot load deformation. Standard and special sizes and types. We will design car top arrangements for any type ceramic ware; any type firing.

Weight per cu. ft. (lb.)	123.4
Porosity (apparent)	23.4%
Thermal Conductivity (A.S.T.M. C201-47)	

	Hot Side deg. F.	Cold Side deg. F.	Ave. Temp. deg. F.	Thermal Conductivity B.T.U./hr/sq. ft/deg. F./in.
1.	364.5	289.7	327.1	8.34
2.	784.1	589.8	687.0	10.5
3.	1133.8	843.7	988.8	10.9
4.	1485.6	1115.4	1300.5	11.9
5.	1823.4	1355.0	1589.2	11.8
6.	2091.0	1547.2	1819.1	12.4
Thermal expansion @ 1200 deg. F.	.4180%			
Load deformation @ 2700 deg. F.	Trace			
Thermal shock	30 cycles			
P.C.E.	(3040 F.) Cone 29-31			
Compressive strength of 4 1/2 x 8 1/2 x 10 inch cartop, gross area 85 sq. in., total load (lb.) 77,750, unit load (lb./sq. in.) 915.				

PACO FIRE BRICK



Designed for service conditions where many fire brick will fail. Made of the mineral pyrophyllite, they are carefully controlled in manufacture. High resistance to load at high temperatures; resists spalling and slag action. Uniform quality; high strength. Standard and special sizes.

	PACO H.H.D.	No-Car (Intermediate duty)
Hot load test (2460 deg. F.)	2.1%	0.7%
Reheat change (2550 deg. F.)	0.2%	0.9%
Porosity	23.4%	26.3%
Panel Spalling loss (2910 deg. F.)	4.9%	12.4%
P. C. E.	cone 29-31 (3040 deg. F.)	cone 27-28 (2930 deg. F.)

PACO HIGH TEMPERATURE CEMENT

All purpose High Temperature Cement is a hydrous alumina silica material especially adaptable where extremely high heat is encountered; resistant to slag action. Great bonding strength; minimum deterioration from sudden temperature changes. Scientifically compounded and machine mixed for uniformity. 100-lb. and 30-lb. drum packed; also 100-lb. bags.





Products for the Ceramic Industry

- **Kiln Furniture**

Batts • Saggars • Supports

- **Kiln and Furnace Parts**

Muffles • Tile • Plates

- **CRYSTOLON Heating Elements**

- **Refractory Grain**

ALUNDUM® aluminum oxide

CRYSTOLON® silicon carbide

MAGNORITE® magnesium oxide

Zirconium oxide

- **Grinding Wheels**

Diamond Wheels

ALUNDUM® Wheels

CRYSTOLON® Wheels

- **Abrasive Grain**

ALUNDUM® Grain

CRYSTOLON® Grain

ARROW-BLAST® Grain

- **Other Abrasive Products**

Mounted Wheels

Abrasive Sticks

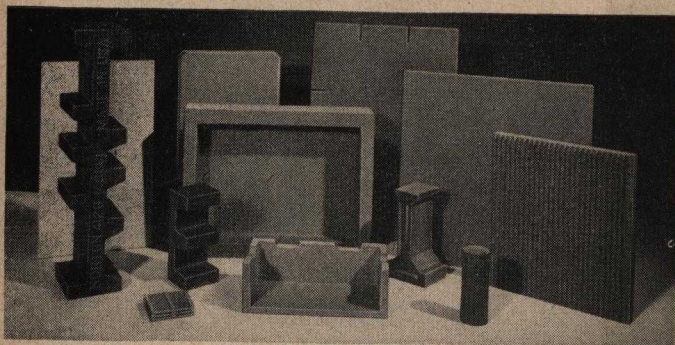
*Making better products...
to make your products better*

Kiln Furniture . . . Kiln and Furnace Parts

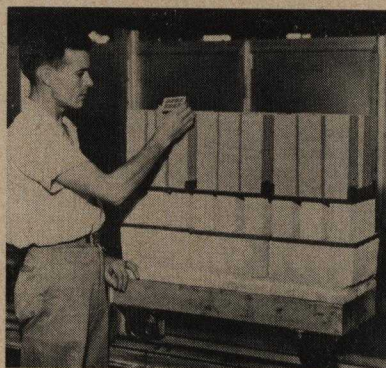
CRYSTOLON Kiln Furniture

This quality-controlled kiln furniture is a valuable aid to trouble-free, economical firing in the widest range of operations. It is *engineered and prescribed* to meet your exact requirements for refractoriness, strength and cleanliness — plus resistance to warpage, dimensional changes and thermal shock.

Some of the various types of settings in which CRYSTOLON kiln furniture is widely used are shown here. For further information, ask your Norton Representative for the new Norton illustrated booklet, *Refractories for the Ceramic Industry—Form 630*, or write for your copy. It describes the properties of various refractory materials, their advantages for different uses, and contains many engineering tables, charts and other useful data.



CRYSTOLON kiln furniture — batts, saggars, supports and setter plates — is available in a wide variety of sizes and shapes.

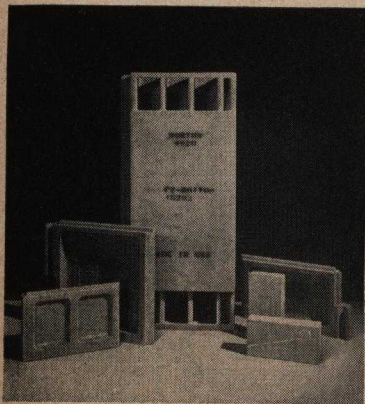


Firing heavy load of electrical insulators supported on CRYSTOLON kiln furniture. Note "Christmas tree" supports which lend flexibility to settings and provide maximum setting space.

◀ Nonreactive Fused Stabilized Zirconia Setter Plates are widely used for firing highly reactive titanate dielectrics.

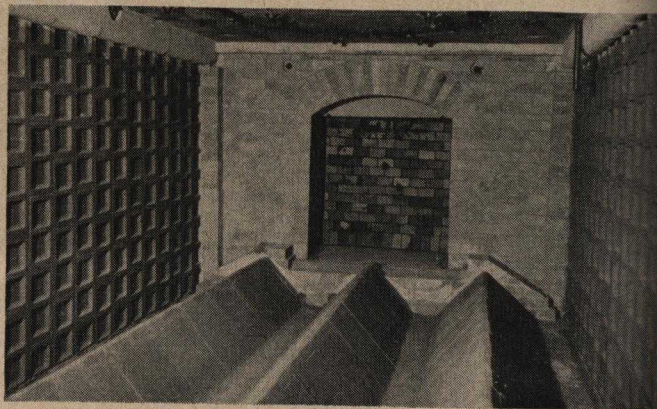
Kiln and Furnace Parts

Norton ALUNDUM and CRYSTOLON parts for ceramic kilns are designed to cut your labor, fuel and maintenance costs, as well as to help improve the quality of your ware.



Norton kiln and furnace parts — muffles, tile, baffle plates and brick — are made of ALUNDUM and CRYSTOLON refractory materials.

ALUNDUM parts in this enameling furnace consist of muffle tile and half-tile of tongue and groove design, and the Manion "V" bottom.



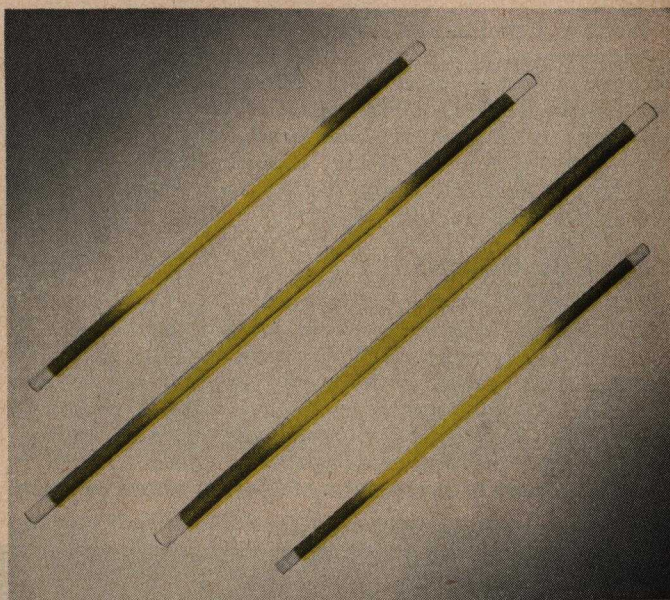
CRYSTOLON Heating Elements

Thorough comparative testing, in a wide variety of electric kilns and furnaces, has proved that Norton CRYSTOLON heating elements — known as “Hot Rods” — outlast other elements by a wide margin.

This greatly increased service life means new economy in kiln operation. Additional advantages naturally resulting from it are: savings in element costs, because fewer “Hot Rods” are required; reduced maintenance, due to less frequent changing; fewer changes in voltage taps; and less interference with the smooth flow of production.

Write for detailed literature on CRYSTOLON heating elements, including helpful suggestions on increasing element life and recommendations for electrical connections and methods of mounting—**Form 146**.

Norton CRYSTOLON heating elements, or “Hot Rods,” are made of self-bonded silicon carbide, each rod having a central hot zone and cold ends. Aluminum-sprayed tips and metal impregnated ends minimize resistance and power loss. One-piece Hot Rods—available now in most popular sizes—are interchangeable with your present rods. This non-welded construction assures greater strength and uniform straightness throughout each element.



Electric Furnace Materials

Norton Company produces a number of fused, electrochemically refined materials with special inherent characteristics and properties designed to meet the requirements of the ceramic industry.

Large quantities of electrically fused oxides and silicon carbide in grain form are supplied as raw materials for use in all types of ceramic bodies as well as for high tempera-

ture refractory products. ALUNDUM fused alumina; CRYSTOLON silicon carbide; MAGNORITE fused magnesia; Fused Stabilized Zirconia (cubic) and Fused Monoclinic Zirconia; NORBIDE Boron Carbide and other materials are also available.

The booklet, **Norton Refractory Grain—Form 1741** provides complete details. The chart below shows important properties of these materials.

Norton Electric Furnace Materials—Comparative Properties

MATERIAL	PURITY	MELTING POINT	TRUE SPECIFIC GRAVITY	THERMAL CONDUCTIVITY	THERMAL EXPANSION— in/in/°F from 70-2500°	ELECTRICAL RESISTANCE
Fused Alumina Al_2O_3	95 to 99% ^o	3450°F to 3630°F	3.95	High	44×10^{-7}	High
Silicon Carbide SiC	98.13	4170°F dissociates	3.20	Very High	29×10^{-7}	Good Conductor
Fused Magnesia MgO	96.39	4750°F	3.58	High	89×10^{-7}	Very High
Fused Cubic Zirconia ZrO_2	92	4620°F	5.6 to 5.7	Low	52×10^{-7}	High Temp. Conductor
Fused Monoclinic Zirconia ZrO_2	89 to 95	4800°F to 4900°F	5.6 to 5.7	Low	42×10^{-7}	High Temp. Conductor
Boron Carbide B_4C	97 to 99	4440°F	2.51	High	25×10^{-7}	Conductor

Every Abrasive Product

Norton Company supplies the ceramic and glass industries with a complete line of abrasive grains and bonded abrasive products. Made of ALUNDUM* (aluminum oxide), CRYSTOLON* (silicon carbide) and diamond abrasives, these products are backed by the extensive manufacturing, engineering and research facilities of the world's largest manufacturer of abrasives and abrasive products.

ABRASIVE GRAINS

Made under strict quality control, Norton abrasive grains are thoroughly uniform in size, structure and chemical composition. Which means thoroughly uniform cutting action, with no over-size grains to mar surfaces and no flats, slivers or undersized grains to loaf on the jobs. And you can count on exact duplication of these performance-improving characteristics in every shipment of every type of Norton abrasive grain.



Improved CRYSTOLON Grain

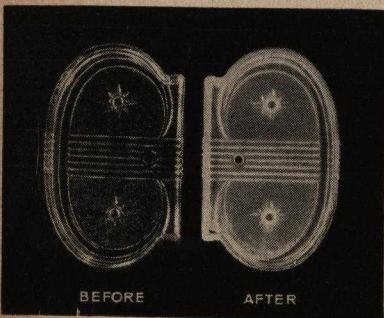
This hard, sharp silicon carbide abrasive is used for many ceramic and glass applications. Fast cutting action and high resistance to breakdown are among its advantages.

ALUNDUM Grain

A hard, tough aluminum oxide abrasive that is used in sizes as fine as 320 for a wide variety of semi-finishing operations on glass—especially for surfacing lenses.

ARROW-BLAST* Grain

This fast-cutting, long-lasting aluminum oxide grain is designed especially for pressure blasting. In the glass industry, it is used to give products a "frosted," light-diffusing surface, as shown.



*Trade-marks Reg. U. S. Pat. Off. and Foreign Countries

OTHER ABRASIVE PRODUCTS

Disc Wheels

Norton discs of CRYSTOLON abrasive, resinoid bonded, are used for many surfacing operations in ceramic plants, and also in glass plants for edging and beveling work and for sizing container ware. Available in sizes and mountings to fit all types of disc grinders.



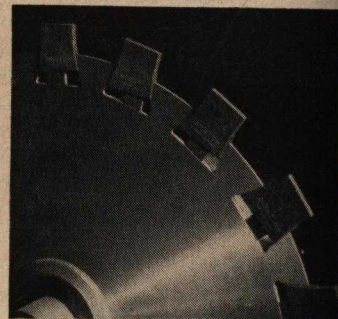
Lens Edging Wheels

Three types of Norton abrasive wheels are recommended for lens grinding. Strong, sharp CRYSTOLON wheels are right for heavy stock removal. Tough, fast-cutting 19 ALUNDUM wheels are excellent for semi-finishing. And wheels of durable regular ALUNDUM abrasive are preferred for finishing.



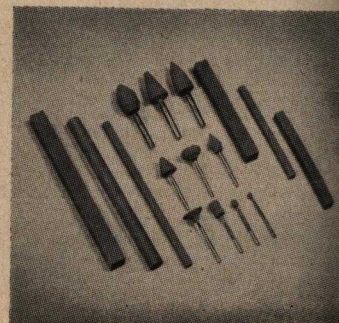
Inserted Teeth

Sawing glass tank blocks and large refractory parts is fast, trouble free and economical when you use CRYSTOLON teeth in your inserted tooth saws. Solid CRYSTOLON wheels, resinoid bonded, are also available for cutting ceramics and glass.



Mold Finishing Wheels and Sticks

Norton manufactures a complete line of products for making and maintaining dies and molds in ceramic and glass plants. These include abrasive sticks and mounted wheels and points in a wide variety of sizes and shapes. Made of ALUNDUM abrasive, they are just right for working hard alloy steels.

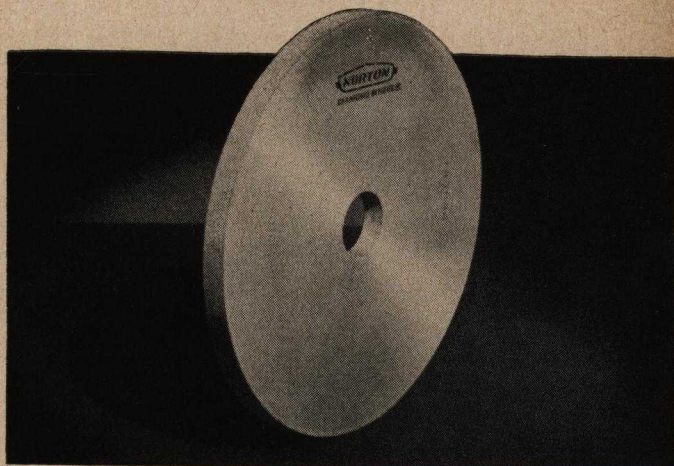


For Every Application

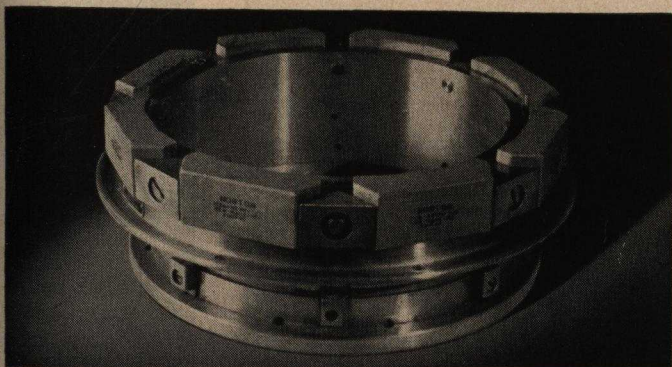
DIAMOND WHEELS

Engineered for lasting economy that far outweighs initial cost, Norton diamond wheels are made in types and sizes for every grinding job you do. Besides their superiority in many glass grinding jobs, they are unequalled for grinding ceramics of all degrees of hardness—including steatites, fused alumina, electrical porcelain and many others. In fact, there are many grinding jobs in ceramics that have been made practical by the use of Norton diamond wheels.

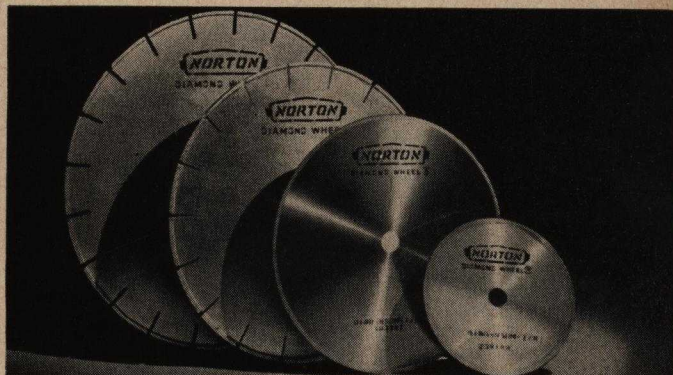
Even after removing several times as much stock as ordinary wheels they show practically no wear. They enable you to hold consistently close tolerances and produce an excellent finish. And their extra-long, productive service life means daily savings that add up to worthwhile profits.



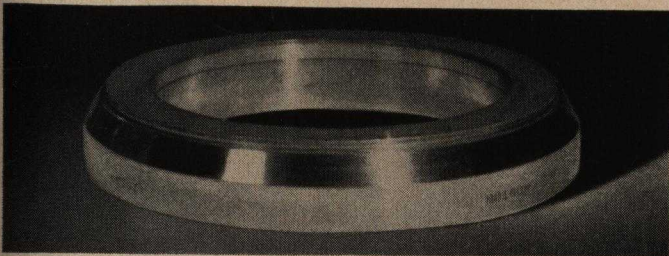
Straight diamond wheel for cylindrical and surface grinding



Diamond segments in chuck for surface grinding



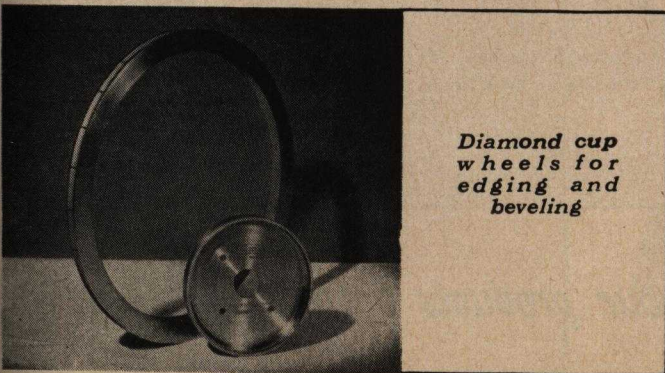
Segmented and continuous rim diamond wheels for cutting off



Diamond cylinder wheel for surface grinding



Diamond lens grinding wheels



Diamond cup wheels for edging and beveling



Diamond wheels for internal grinding

... for the Ceramic Industry

NORTON COMPANY

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Cleveland 3: 1306 East 55th Street
Detroit 8: 5805 Lincoln Avenue
Philadelphia 44: 4732 Stenton Avenue
Pittsburgh 23: Butler Road, Glenshaw

DISTRICT OFFICES AT:

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West Hartford 7: 1007 Farmington Avenue
Los Angeles Area: Huntington Park, 5905 Pacific Blvd.
St. Louis 16: 4085 Bingham Avenue
Atlanta Area: 5200 Peachtree Road, Chamblee
Indianapolis 2: 1301 West 16th Street

PLANTS:

Abrasive and Grinding Wheel Plants: Worcester, Mass.; Santa Clara, California; Hamilton, Ontario; England; France; Germany; Italy; South Africa; Brazil

Refractories Plant: Worcester, Mass.

Electrochemical Plants: Chippawa, Ontario;
Cap-de-la-Madeleine, Quebec; Huntsville, Alabama

Grinding and Lapping Machine Plant: Worcester, Mass.

Electric Furnace Plants: Huntsville, Alabama; Chippawa, Ontario;
Cap-de-la-Madeleine, Quebec; Belo Horizonte, Brazil; Mendoza, Argentina; Hull, England

Bauxite Plant: Bauxite, Arkansas

DIVISIONS:

Behr-Manning Company, Troy, New York
Norton Pike, Littleton, New Hampshire

EXPORT:

NORTON BEHR-MANNING OVERSEAS INC.
Cable Address: NORBEMO, Worcester 6, Mass., U.S.A.



NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals
BEHR-MANNING PRODUCTS: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

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American Smelting & Refining Company

CERAMIC FLUORSPAR

CHEMICAL ANALYSIS:

CaF ₂	97.01%	Min.
CaCO ₃ — SiO ₂	2.50%	Max.
Res. Oxides	.50%	Max.
Ether Soluble	.009%	Max.
Fe	.03%	Max.

SHIPMENTS:

Box cars — 30 N.T. minimum:
covered hopper bottom cars
— 60 or 70 N.T. minimum.

Available in bulk or bagged

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"MINAC" Brand

Oglebay Norton Company is the exclusive sales agent for American Smelting and Refining Company's "Minac" brand ceramic fluorspar. The association of these two leading companies in this field assures our customers quality, reliability and availability of product.

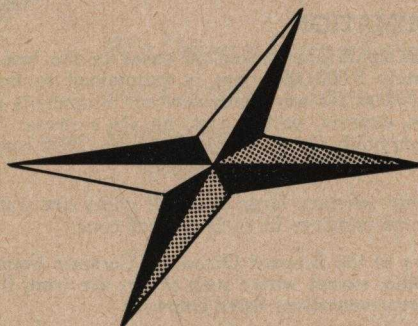
Chemical and Physical Analyses

Following are the chemical and physical analyses of the two grinds of "Minac" brand fluorspar available for shipment. Although the calcium fluoride content is guaranteed 97% minimum, shipments average 98% and other constituents decrease. You will note that the iron content is particularly low and other deleterious elements, such as lead, zinc and sulfur, are relatively non-existent. We will gladly furnish samples of any or all grinds.

PHYSICAL (Typical Mesh Analysis)

	Medium "A" Grind	Fine "C" Grind
Thru 10 mesh	100.0%	100.0%
Thru 48 mesh	95.0%	99.3%
Thru 65 mesh	88.0%	97.3%
Thru 100 mesh	71.0%	92.5%
Thru 150 mesh	56.0%	80.8%
Thru 200 mesh	41.0%	67.3%
Thru 325 mesh	10.7%	33.0%

OGLEBAY



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THE EDWARD ORTON JR. CERAMIC FOUNDATION

1445 Summit Street
P. O. Box 8446-Str. A

Columbus 1, Ohio
Phone: AXminster 9-8023

ORTON STANDARD PYROMETRIC CONES

Since 1896 Orton Standard Pyrometric Cones have been continuously furnished to the ceramic industry both in this country and abroad. Orton cones are manufactured under a system of rigid control of raw materials, process, and finished product. Each batch of cones manufactured is thoroughly checked against standard test cones, a stock of which has been maintained for many years. This assures the user of a continuous, dependable source of cone supply.

All cones are machine made, with de-aging being used in the production of the large cones. Cones produced by this process are uniform in size, true in shape, and accurate in deformation behavior.

LARGE CONES (2½")—This series is made in all cone numbers (022-42), except cones 21, 22, 24, and 25. Cone No. 32½ is also made for this series.

LARGE CONES, iron free (2½")—This series is made in cone numbers from No. 010 to No. 3, inclusive, and is for use when reducing conditions are necessary in firing.

SMALL CONES (1½")—This series is made in cone numbers from No. 022 to No. 12, inclusive, and is for use in small kilns, inside of saggars, and other places where space is limited. The deformation temperature values for the cones in this series are somewhat higher than those of the large cones in the same numbers, at the same rate of heating.

P.C.E. cones (1½")—This series is made in cone numbers from No. 12 to No. 42, inclusive (except Nos. 21, 22, 24 and 25). Cones No. 31½ and 32½ are also made for this series.

CONE PLAQUES AND CONE MOLDS

Plaques for either large or small cones are available in two grades (1) for firings up to Cone 12 and (2) for firings up to Cone 36. Steel molds for making P.C.E. test cones are also available. Please write for information.

THE USE OF CONES

Pyrometric cones are used (1) to determine the rate of heating during the last stage of kiln firing; (2) to determine the end point of firing, and (3) to determine the heat distribution throughout the kiln chamber. In addition to the use of a reliable cone, it is necessary that the cones used be placed in a suitable refractory plaque and set to a uniform height and be inclined at an angle of 8 degrees from the vertical. The cone plaque should also be placed or shielded in the kiln so that it will not be exposed to excessive radiation from hot fire boxes, walls, etc., or to the action of flames. Proper use of the cones will assure dependable and reproducible firing operations.

GENERAL INFORMATION

All cones, large and small, are packed 50 cones to the box. A stock of approximately 3,000,000 cones is maintained to insure prompt delivery of orders for any cones desired. Shipments may be made by freight, express, parcel post, or air express. The largest shipping carton holds 50 boxes of large cones (2500 cones), measures 16" x 17" x 15", and weighs 54 pounds.

When ordering specify whether large or small cones are wanted in addition to the cone numbers in each type of cone.

Direct foreign orders to the Edward Orton Jr. Ceramic Foundation at Columbus, Ohio, except where such orders are from those areas served by the representatives listed below.

REPRESENTATIVES

South America—Ferro Enamel, S. A., Avellaneda F. C. S., Argentina; Ferro Enamel, S. A., Sao Paulo, Brazil. **Mexico and Central America**—Ferro Enamel De Mexico, S. A. Calle Oriente 171, Num. 450, Col. Aragon, Mexico 14, D. F. **International**—International Division Ferro Corp., 4150 E. 56th Street, Cleveland 5, Ohio. **Europe**—Allied Engineering Div., Ferro Enamels, Ltd., Wombourne, Wolverhampton, England. **Canada**—Ferro Enamels (Canada), Ltd., Oakville, Ontario.

TEMPERATURE EQUIVALENT

Rate of Heating Cone No.	LARGE CONES				SMALL CONES	
	60°C.	108°F.	150°C.	270°F.	300°C.	540°F.
	*C.	*F.	*C.	*F.	*C.	*F.
022	585	1085	600	1112	N.D.*	....
021	602	1116	614	1137	643	1189
020	625	1157	635	1175	666	1231
019	668	1234	683	1261	723	1333
018	696	1285	717	1323	752	1386
017	727	1341	747	1377	784	1443
016	767	1407	792	1458	825	1517
015	790	1454	804	1479	843	1549
014	834	1533	838	1540	N.D.*	....
013	869	1596	852	1566	N.D.*	....
012	866	1591	834	1623	N.D.*	....
011	886	1627	894	1641	N.D.*	....
010	887	1629	894	1641	919	1686
09	915	1679	923	1693	955	1751
08	945	1733	955	1751	983	1801
07	973	1783	984	1803	1008	1846
06	991	1816	999	1830	1023	1873
05	1031	1888	1046	1915	1062	1944
04	1050	1922	1060	1940	1098	2008
03	1086	1987	1101	2014	1131	2068
02	1101	2014	1120	2048	1148	2098
01	1117	2043	1137	2079	1178	2152
1	1136	2077	1154	2109	1179	2154
2	1142	2083	1162	2124	1179	2154
3	1152	2106	1168	2134	1196	2185
4	1168	2134	1186	2167	1209	2208
5	1177	2151	1196	2185	1221	2230
6	1201	2194	1222	2232	1255	2291
7	1215	2219	1240	2264	1264	2307
8	1236	2257	1263	2305	1300	2372
9	1260	2300	1280	2336	1317	2403
10	1285	2345	1305	2381	1330	2426
11	1294	2361	1315	2399	1336	2437
12	1306	2383	1326	2419	1355	2471
13	1321	2410	1346	2455		
14	1338	2530	1366	2491		
15	1424	2595	1431	2608		
16	1455	2651	1473	2683		
17	1477	2691	1485	2705		
18	1500	2732	1506	2743		
19	1520	2768	1528	2782		
20	1542	2808	1549	2820		
23	1586	2887	1590	2894		
26	1589	2892	1605	2921		
27	1614	2937	1627	2961		
28	1614	2937	1633	2971		
29	1624	2955	1645	2993		
30	1636	2977	1654	3009		
31	1661	3022	1679	3054		
32	1706	3103	1717	3123		
32½	1718	3124	1730	3146		
33	1732	3150	1741	3166		
34	1757	3195	1759	3198		
35	1784	3243	1784	3243		
36	1798	3268	1796	3265		

All values given in °C. are average values as determined at the National Bureau of Standards. *Not Determined.

FOR P.C.E. CONES (Rate of Heating 150° C. or 270° F. /Hour)

Cone No.	*C.	*F.	Cone No.	*C.	*F.
12	1337	2439	31	1683	3061
13	1349	2460	31½	1699	3090
14	1398	2548	32	1717	3123
15	1430	2606	32½	1724	3135
16	1491	2716	33	1743	3169
17	1512	2754	34	1763	3205
18	1522	2772	35	1785	3245
19	1541	2806	36	1804	3279
20	1564	2847	37	1820	3308
23	1605	2921	*38	1835	3335
26	1621	2950	**39	1865	3389
27	1640	2984	40	1885	3425
28	1646	2995	41	1970	3578
29	1659	3018	42	2015	3659
30	1665	3029			

*Heated at 100° C. per hour. Data for last five cones from "Characteristics of Pyrometric Cones" by Fairchild & Peters, J. Am. Cer. Soc., Vol. 9, Nov. 1926.

**The last four cones were heated 600° per hour. Temperature data for large Orton Cones Nos. 022-36 incl., Small Orton Cones 021-12 incl. and Orton P.C.E. Cones No. 12-42 incl. when heated at rates shown as determined by The National Bureau of Standards 1954.

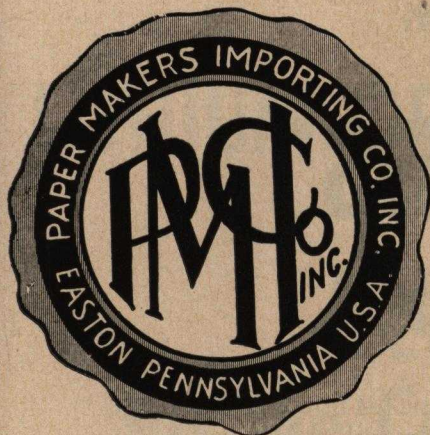
WRITE TODAY FOR "The Properties and Uses of Pyrometric Cones" — IT'S FREE!

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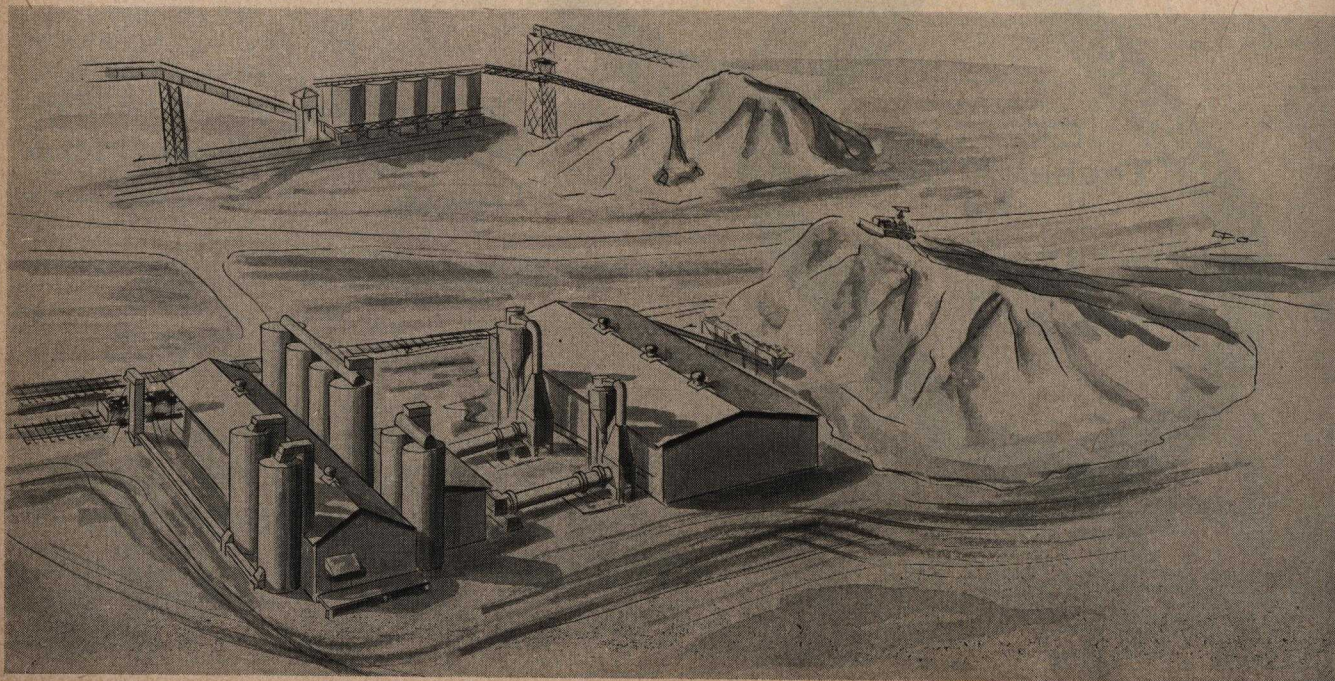
GLASS MAKERS' FELDSPAR and SILICA



Paco Products, Inc., is now in the process of constructing a new mill at Pacolet, S. C., complete with the most modern research and testing facilities. The new mill will be in full production early in 1959. Rigid manufacturing controls will be employed to assure consistent high quality of every shipment. Reserves are unlimited. Delivery by rail or truck on daily, weekly or monthly schedules, in any quantity, is assured. Shipping point—Calico, S. C.

Feldspar and silica are now being produced on a fully equipped pilot plant basis. Samples from the pilot plant operations are now available for your examination.

For further information write or telephone C. Tennant, Sons & Co., of New York, Ceramic Sales Dept., at 100 Park Ave., New York 17, N. Y. Telephone—ORegon 9-1300.



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100 Park Avenue, New York 17, N. Y.

LITHIUM ORE (SPODUMENE)

and

FELDSPAR

for the Ceramic Industry



C. Tennant, Sons & Co., of New York represents the Quebec Lithium Corporation for the sale of their ceramic grade Spodumene and Feldspar in the United States.

Quebec Lithium's modern mill at Fisher's Station, near Val d'Or, Quebec, Canada, has been in operation since 1956, and has been producing ceramic grade Spodumene and Feldspar for the U. S. and Canadian ceramic industry since 1957. Continuous production controls assure uniform high quality of every shipment. Reserves are unlimited. Carload quantities are available from stock on a daily, weekly or monthly schedule.

For further information write or telephone C. Tennant, Sons & Co., of New York, Ceramic Sales Dept., at 100 Park Ave., New York 17, N. Y. Telephone—ORegon 9-1300.

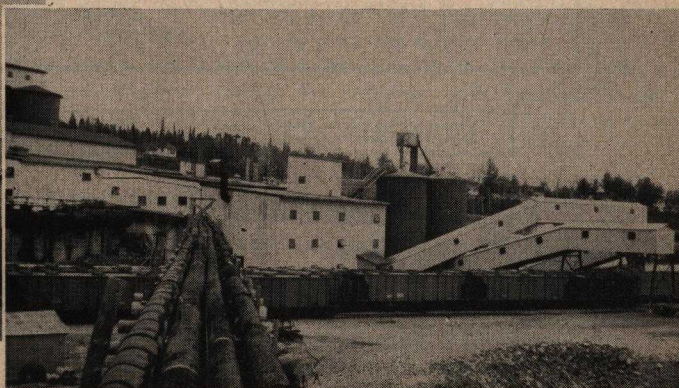
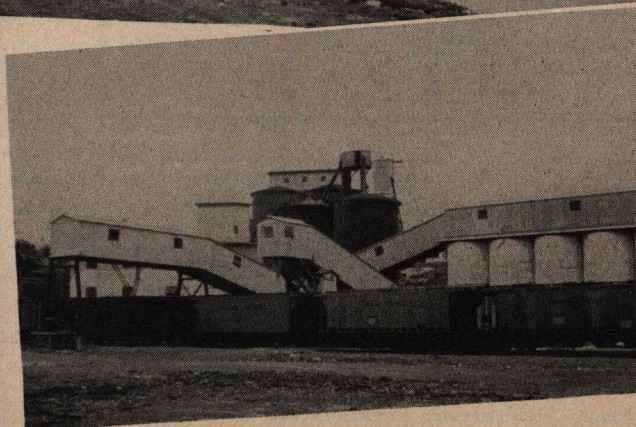


Representative Chemical and Screen Analyses SPODUMENE

Chemical Analysis		Screen Analysis	
		U.S.S. Sieve No.	% by weight
Li ₂ O	6.00%	+ 40	2.3
Na ₂ O	1.10	+ 60	43.4
K ₂ O	0.75	+ 80	30.6
Al ₂ O ₃	24.50	+100	13.7
Fe ₂ O ₃	0.45	+200	9.1
SiO ₂	66.80	- 200	0.9
CaO	nil		
MgO	nil		
Mn	nil		
Loss on Ignition	0.38		

FELDSPAR

Chemical Analysis		Screen Analysis	
		U.S.S. Sieve No.	% by weight
SiO ₂	67.78%	+ 30	none
R ₂ O ₃	19.42	+ 40	0.1
Na ₂ O	7.85	+ 50	1.4
K ₂ O	4.59	+ 70	14.5
CaO	nil	+100	35.8
MgO	nil	+140	28.0
Li ₂ O ₃	0.12	+200	17.6
Fe ₂ O ₃	0.075	+270	2.0
Loss on Ignition	0.27	- 270	0.1
1100°C.			





PEMCO CORPORATION

BALTIMORE 24, MARYLAND

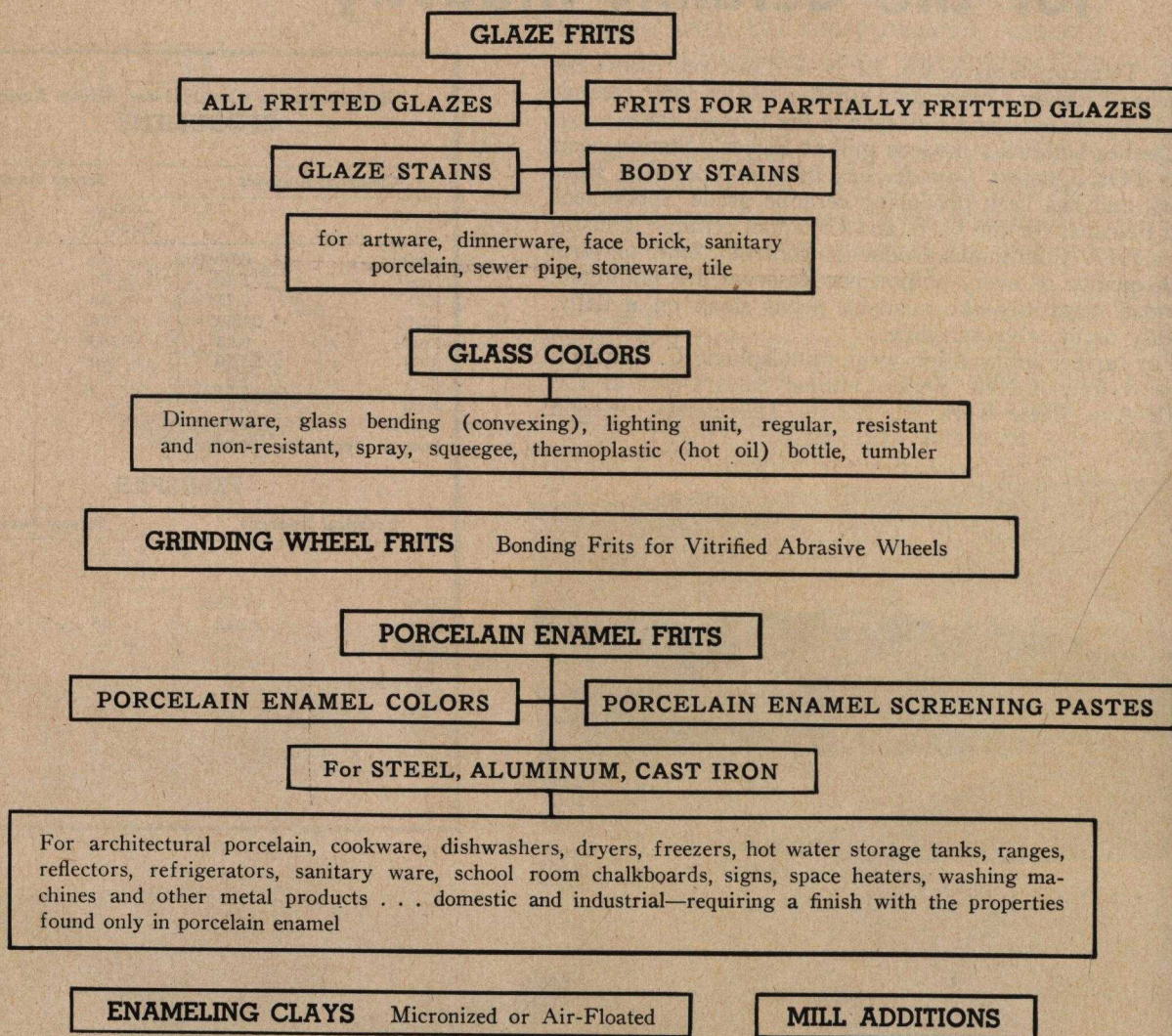
*Manufacturers of
"The World's Finest"
Materials for
Ceramic Coatings*

Since 1910, the Pemco Corporation has been recognized as the industry's pioneer in the development and production of commercial frits, glazes, colors and related products. Many "firsts" are to its credit. In fact, Pemco was the first to devote its complete effort and facilities toward reaching the ideal three-fold goal of combining objective research and development, dependable produc-

tion and competent service in order to further the growth of the ceramic industry.

Many of the processes used in the industry and many of the procedures used to manufacture products the industry uses can be attributed to Pemco's devotion to its purpose.

The Pemco staff of ceramic engineers has an outstanding record of accomplishment. And, this staff is aided by the most modern of laboratories, the most exacting manufacturing controls and the latest types of production equipment to assure the uniformity and dependability of a given Pemco Product.



We invite manufacturers of APPLIANCES, CHEMICALS AND FOOD, COMPONENTS FOR INDUSTRIAL MACHINERY, ELECTRICAL EQUIPMENT, FARM EQUIPMENT, MATERIALS HANDLING EQUIPMENT, METAL PRODUCTS REQUIRING WEAR OR WEATHER RESISTANT FINISHES, PROCESSING EQUIPMENT FOR PETROLEUM to discuss their finish problems. If a ceramic coating is desirable and possible—Pemco engineers can develop the proper product and Pemco Field Service Engineers will assist enameling department or contract enameler in obtaining finish and quality desired.

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A very important reason why you should pre-test blender equipment for your ceramic formulations—First, precision blending of ceramic bodies is becoming more vital in order to meet the higher standards of today's competitive markets. Second, the new liquid-solids blending concept is so revolutionary that only through actual pre-testing of your particular ceramic formulations will you be able to realize the tremendous production benefits that can be achieved. This new blending principle is extremely fast and in most cases, eliminates costly and time-consuming steps such as mulling, pulverizing, screening and curing. The desired spherical granulation size of uniform moisture content can be accurately controlled in the **p-k** Liquid-Solids* blender by blending in minimum air entrainment. The **p-k** liquid-solids blender is dust-tight, easy-to-clean (just hose down) and requires little or no maintenance. Exclusive mechanical seals prevent dust

or liquid from entering the bearing housings. Pre-testing of your formulations will prove that the new **p-k** liquid-solids blender is superior in every respect.

Essentially, the **p-k** liquid-solids blender operates in the following manner. Water is introduced into a rapidly revolving bar (by gravity or pump). The water is flung outward in a finely divided state from a distributor disc and feeds a continuous fine spray into the tumbling mass of dry materials. A series of stainless steel wires, strung horizontally across the bar further promotes liquid dispersion.

Two water and dust-tight quick-opening covers allow easy access to the baffle-free interior for cleaning. **p-k** liquid-solids blender is available in sizes ranging from 1 to 50 cu. ft. working capacity.

*Patents pending.

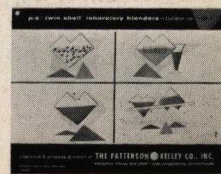
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PRODUCTION BLENDERS

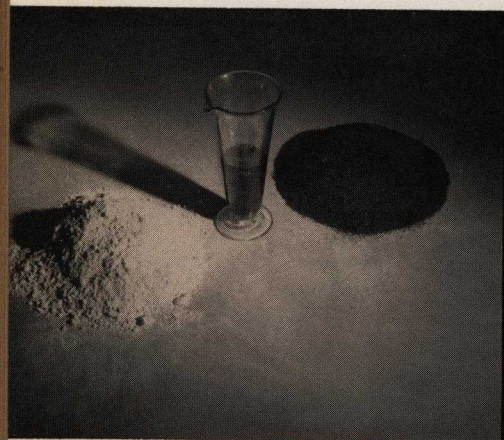
Blending results obtained in the **p-k** laboratory Liquid-Solids blender can be duplicated in larger production sizes. For complete information regarding production size blenders, please write for **p-k** Catalog Number 16.

LABORATORY BLENDERS

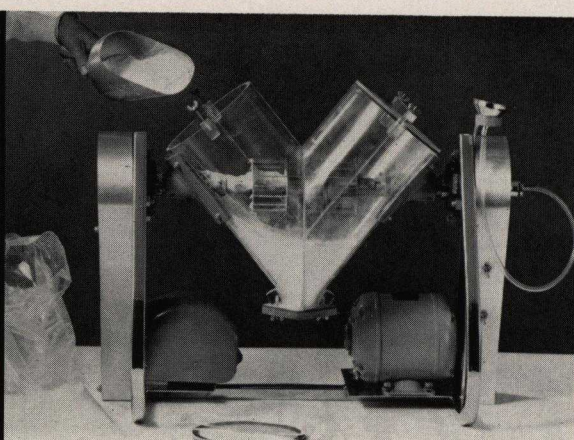
For complete information and price list on **p-k** laboratory Liquid-Solids blender, write for **p-k** Catalog Number 15-A-1.



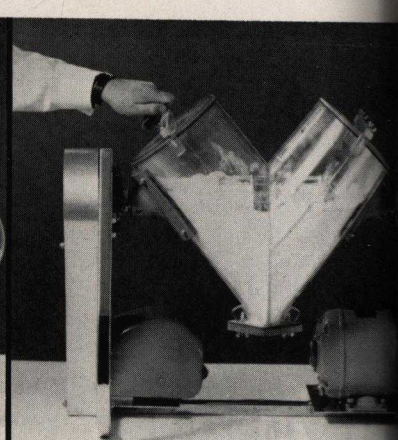
CERAMIC ENGINEERS PROVE BY PRE-TESTING



This picture illustrates the before-and-after of various ceramic components. Dye was added to water to show uniform dispersion.

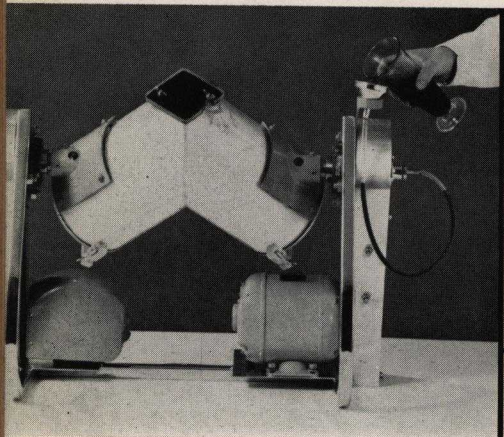


Shell can be charged from either of two dust and water-tight covers. Maximum charge level for most material is slightly above the trunnions.

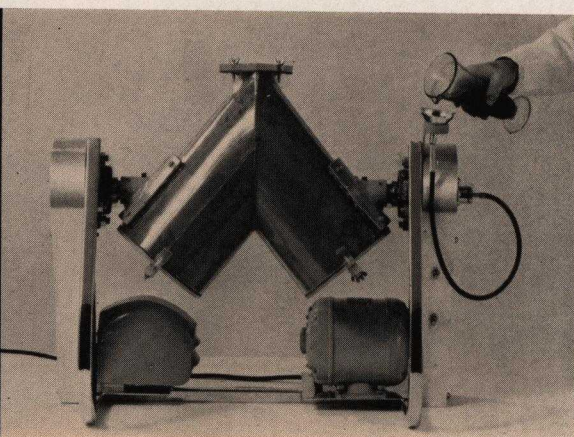


Maximum density rating for standard 8 qt. is 70 lb. per cu. ft. The standard 16 qt. (working) blender is 80 lb. per cu. ft.

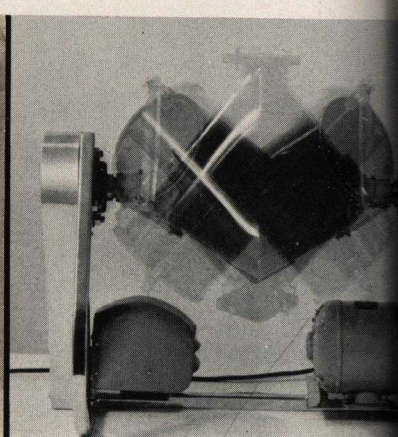
AT p-k's "CUSTOMER-SERVICE" LABORATORY



After charging blender, pre-blend for about 1/2 minute. Exact proportion of water can then be introduced in minutes.

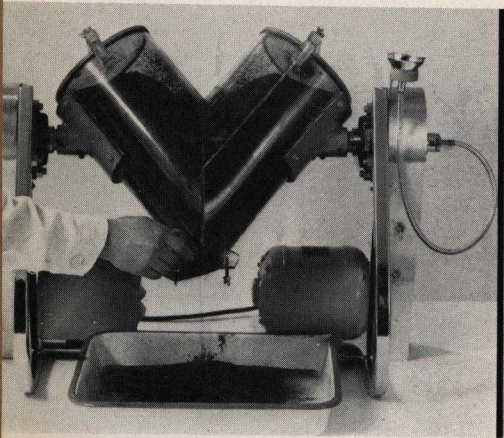


Polyethylene funnel and hose are supplied for gravity feed. Pump for introducing fluids under pressure is available.

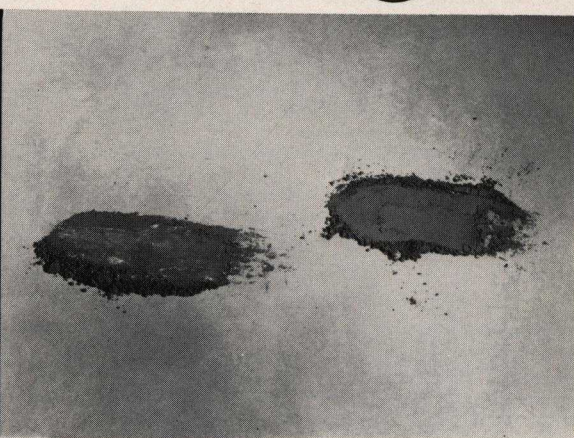


A period of 1 or 2 minutes post-blending is adequate after liquid introduction to obtain dispersion.

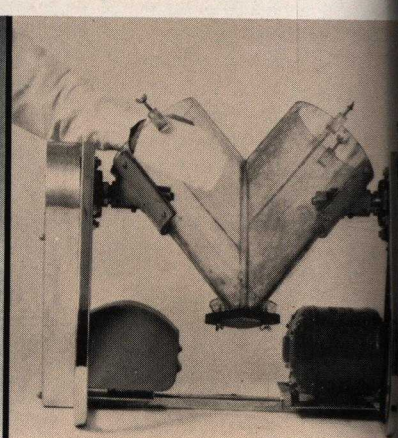
THE SUPERIORITY OF p-k's *Liquid-Solids* BLENDER



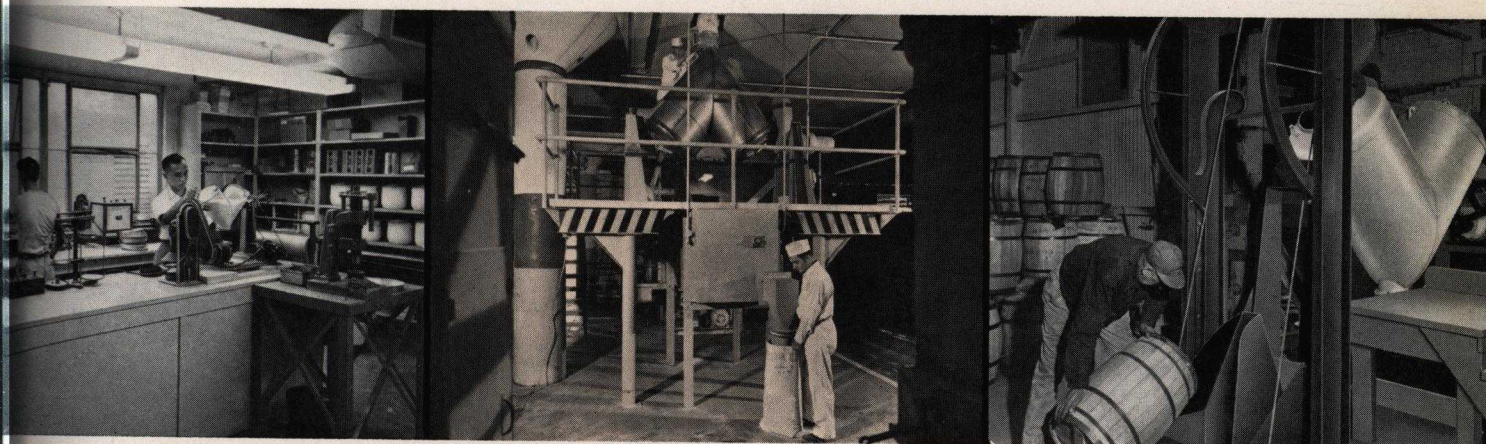
Discharging is accomplished at the apex of the "V". There are no baffles or interior obstructions to prevent complete discharging.



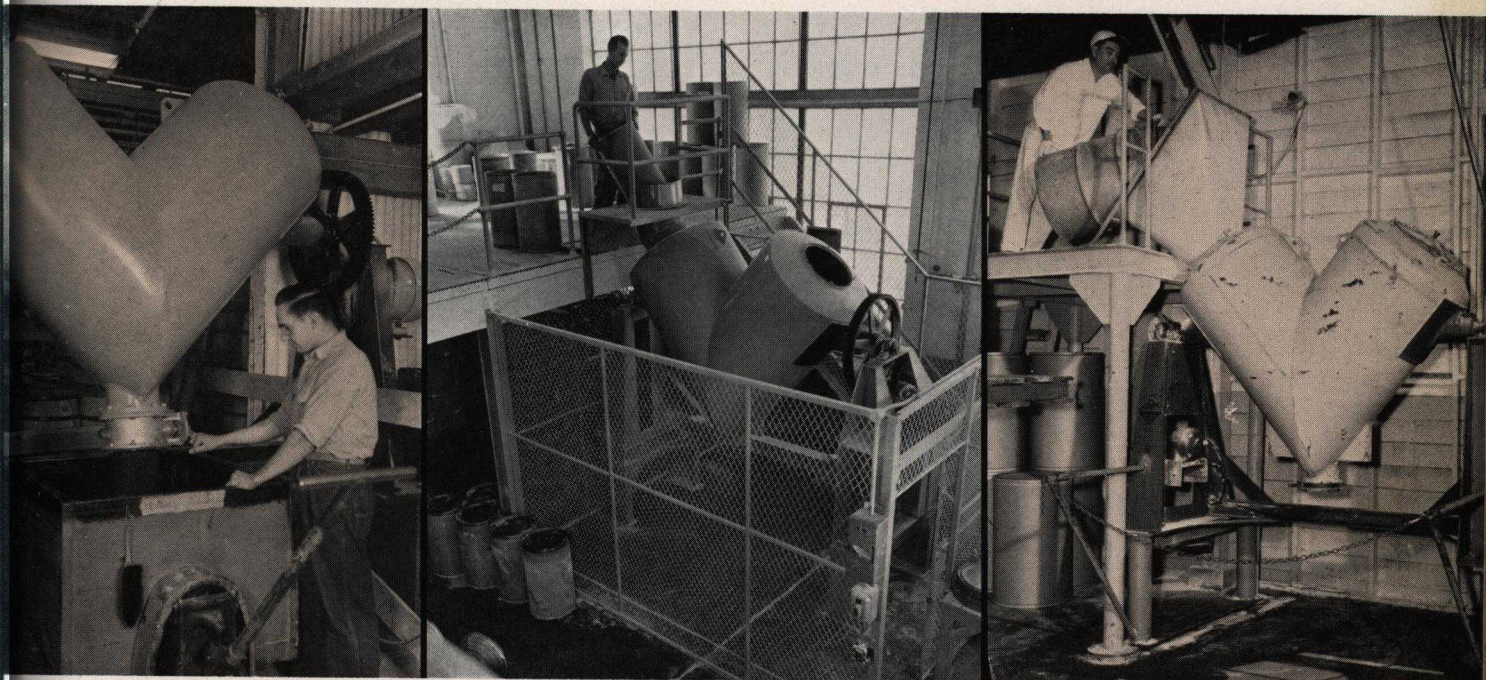
Lab smear test at left reveals results of an inferior mixing method. Note agglomerates and streaks. P-K blend at right indicates complete dispersion.



Note complete accessibility to the smooth shell for cleaning. This allows fast formulation change.



TYPICAL INSTALLATIONS USING THE *Liquid-Solids* BLENDER

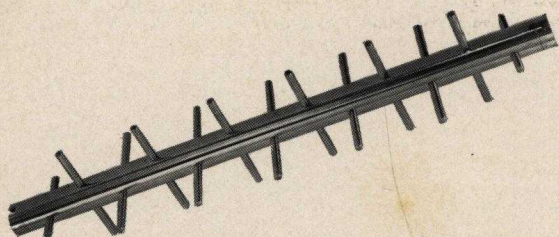


INVESTIGATE **p-k** CUSTOMER SERVICE PROPOSAL

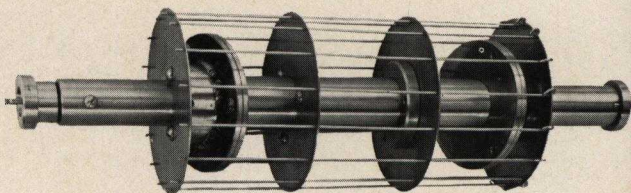
P-K's customer service laboratory will be pleased to test-blend your ceramic formulations, preferably . . . under your supervision. Material formulations will be blended to your exact specifications and returned for analysis, together with a complete report. **p-k** recommends pre-tests for all Liquid-Solids application, because of the many variables that may affect blending procedures necessary for intimate dispersion of liquid in solids. Write Mr. R. T. Dotter, and arrange for a pre-test of your material.

the Patterson  Kelley Co., Inc.

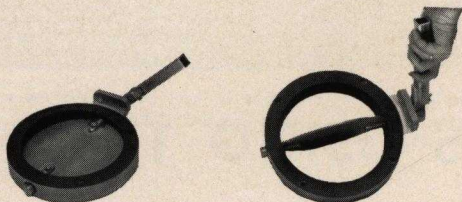
STANDARD COMPONENTS AND DIMENSIONS



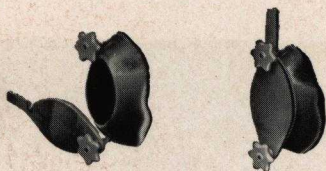
Pin studded p-k intensifier bar used for breaking up agglomerates in dry solids (patented).



16-qt. wire cage Liquid-Feed bar (patented).



Standard p-k wafer valve.



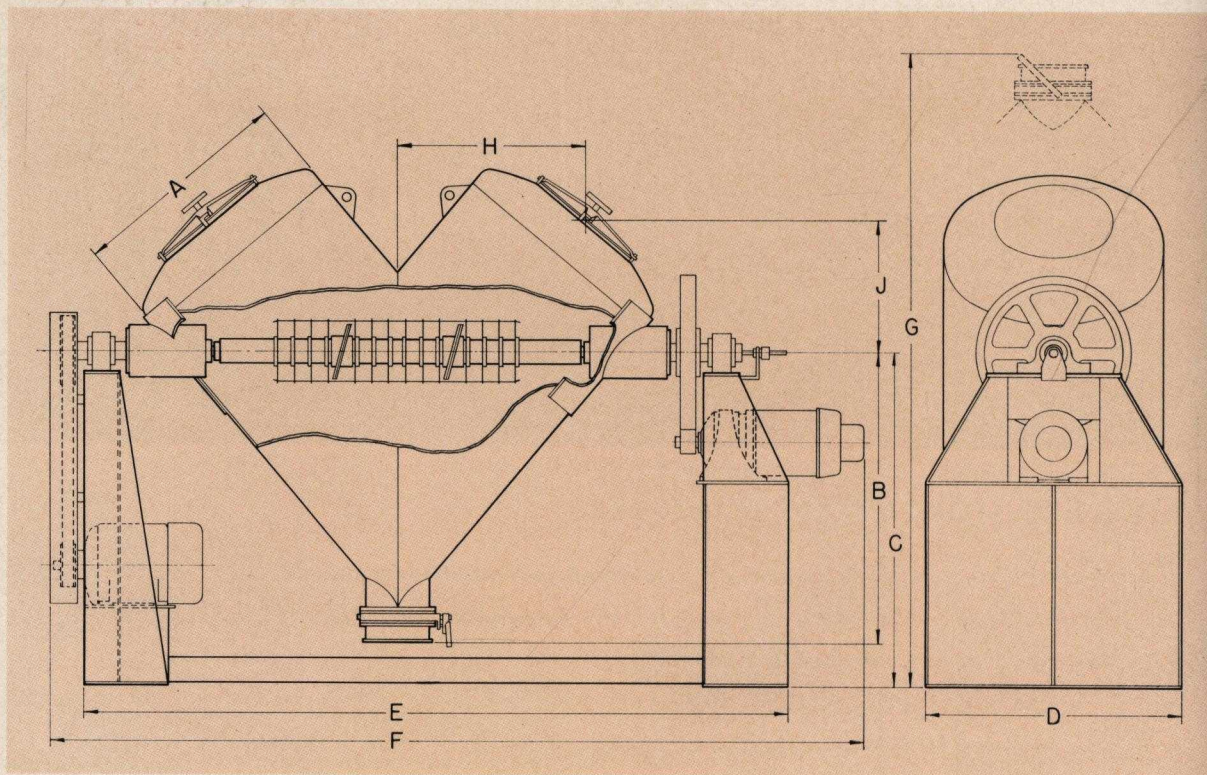
Standard p-k Pivot slide valve.

p-k Liquid-Solids blender

Wrk. Cap. Cu. Ft.	A	B	C	D	E	F	G	H	J	Dis- ch- ge Size	Blend Motor HP	Blend RPM	** Max. Den.
1	11½"	14"	39¼"	26"	42½"	53"	53½"	9¾"	6¼"	4" Slide	¼	30	115
2	14½"	17½"	39¼"	26"	48¾"	60¼"	56¾"	11½"	7½"	4" Slide	½	25	85
3	16½"	23¾"	39¼"	26"	54¾"	70"	63"	13¾"	9¾"	6" Slide	¾	25	135
5	19½"	27¼"	39¼"	26"	64"	80"	69¼"	16"	10¾"	*6"	¾	25	65
10	25"	35¼"	44"	30"	77½"	96"	82¼"	21½"	15¼"	8"	2	20	75
20	30"	41"	48"	36"	90"	109"	92"	25¼"	17¼"	8"	3	16.5	65
30	36"	48¼"	55"	42"	112½"	130"	106¼"	30¾"	21¾"	10"	3	14.7	55
40	40"	52¾"	62½"	46"	122"	143"	118¼"	35"	24½"	10"	5	13.7	65
50	42"	55½"	64½"	48"	127½"	149"	123"	36¼"	25¾"	10"	5	13.7	55

*8" on stainless steel.

**Tabular values under the heading MAXIMUM DENSITIES are in pounds per cubic foot.



the Patterson  Kelley Co., Inc.

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TULSA 3, OKLA.

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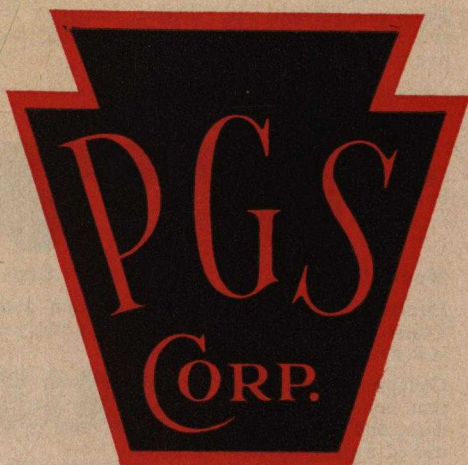
PITTSBURGH, PA.

Eastern Sales Offices

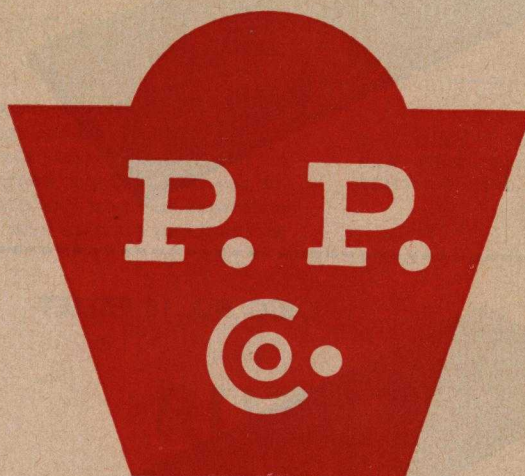
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since 1868*



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REFRACTORIES SAND**



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Painstaking care in production preserves the natural purity of the world's finest quartz deposits, assuring you of unsurpassable quality at all times.

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Highly skilled personnel, working with the ultimate in control equipment and techniques, bring you constant uniformity with every shipment.

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THE OHIO GALVANIZING & MFG. CO.

NILES, OHIO

Pallets

STEEL OR ALUMINUM FOR
DRYING BRICK AND CERAMIC WARE



Trailers

OHIO NO. 8 PALLET



Ohio No. 8 Pallet is a light strong pallet with Rolled Edge encircling the pallet.

OHIO NO. 18 PALLET

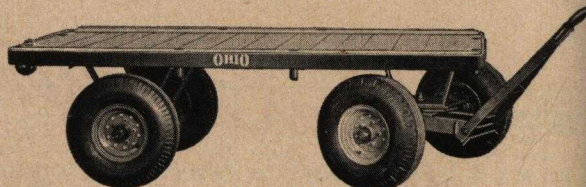


Ohio No. 18 Pallet is a rigid-type of pallet using Square sides and ends.

OHIO NO. 12 PALLET



Ohio No. 12 Pallet with Rolled Sides and Ends and with Air Space for Positive Air Circulation. Ohio Brick Pallets will be manufactured to your requirements in Galvanized Steel—Black Steel or Aluminum.



No. 3003—Size 36" wide x 96" long x 27" high with capacity of 6000 pounds—Fifth Wheel Construction with Pneumatic Tires and Wheels with Timken Bearings. Hardwood Deck and Safety Rear connection. This trailer made in one ton to five ton capacity.

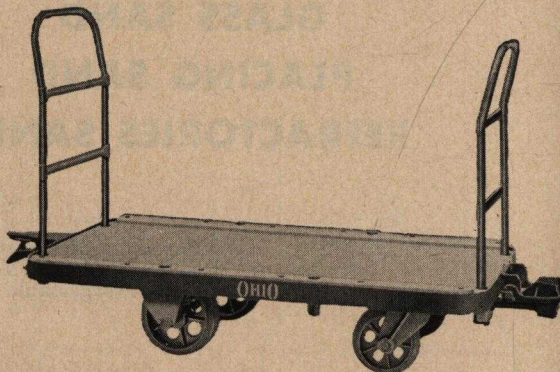


Model No. 401

Capacity 16000 lbs.

Electric Welded Channel Construction and equipped with Pressed-On Rubber Tires. Fabricated steel rear hangers, bolster and ball bearing fifth wheel.

Optional Equipment: Available with stake pockets and rear connections, also with open type deck, lattice or plate deck, and hardwood deck. Spoke Steel Wheels can be furnished instead of Rubber Tires.



One Piece Tee Section Steel Frame Trailers

No. 2001—Size 36" wide x 72" long x 14" high—Two Ton Capacity with Automatic Coupler, Molded-On Tires and Hardwood Top.

Various Platform Sizes may be furnished Heavy Duty Trucks and Trailers to YOUR specifications.

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THE OHIO GALVANIZING & MFG. CO.
NILES " « Established 1902 » " **OHIO**

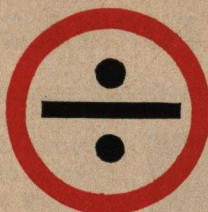
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When you specify "Orefraction," you are assured pure and clean Zircon and Rutile. Exclusive preparation, separation and beneficiation methods—plus fine petrographic and chemical controls—make Orefraction Zircon and Rutile uniformly high in quality. Enlarged control-laboratories, together with new and expanded electrostatic and magnetic separation facilities enable Orefraction to meet your most exacting requirements.

Orefraction ZIRCON

GRANULAR OR MILLED ZIRCONIUM SILICATE
OF MAXIMUM PURITY

Orefraction Zircon has many properties which makes it a superior working material. Its use in glazes gives a whiter, more opaque, brighter, smoother, more closely grained finish. In refractories, the high uniformity of Orefraction Zircon makes it ideal for making press and slip cast refractory shapes of all types. Its dense body, wide maturing ranges at normal firings, high mechanical and dielectric strength and low coefficient of expansion make it ideal for porcelains and special glasses.

USES:

- PORCELAIN ENAMEL
- GLAZES
- OPACIFIERS
- GLASSES
- ZIRCONIUM ALLOYS
- REFRACTORIES
- ELECTRICAL CEMENTS
- ELECTRICAL PORCELAINS
- FOUNDRY SAND, FLOUR & WASHES
- ZIRCONIUM OXIDES

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ENGINEERS
WILL WORK
WITH YOU**



Orefraction Engineers will help you in developing new uses and improving product quality and production efficiency in your present uses for Rutile and Zircon. Write us your problems.

Orefraction RUTILE

GRANULAR OR MILLED . . .
HIGH TITANIUM OXIDE CONTENTS

Orefraction Rutile is used as a colorant in pottery bodies, glazes and enamels. Colors range from ivory through yellows to dark tan according to the amount introduced. Rutile, when used in porcelain enamels, promotes acid resistance in the finish. Amounts up to 2% in other colored glazes tend to reduce crazing and produce matt or crystalline surfaces.

USES:

- COLOR OXIDES
- BODY STAINS
- GLAZES
- ACID RESISTING ENAMELS
- WELDING ROD COATINGS
- TITANIUM ALLOYS

AND MANY OTHER USES

OTHER OREFRACTION PRODUCTS:

- Electrical Insulation Cements: High dielectric, high refractory and high electrical resistance with low leakage values
 - Orelectric Air Setting Cements
 - Orelectric Thermal Setting Cements
- Electrical Insulation Refractory Grain Filling Mix
- Refractory Washes
 - Orwash Sagger Wash: White, super-refractory, non-flaking

Prepared Zircon, Dry Porcelain Mixes

Orefraction's special Zircon Porcelain Mixes make excellent bodies for pressed and extruded ceramic products such as arc chutes, electrical porcelains, combustion boats and similar products requiring high thermal shock resistance, high dielectric resistance and low shrinkage. Send for Data Sheet.



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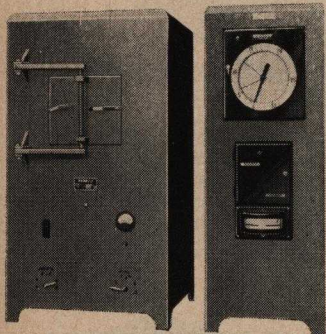
ALL TYPES OF STANDARD AND SPECIAL

PERECO Electric CERAMIC KILNS and FURNACES



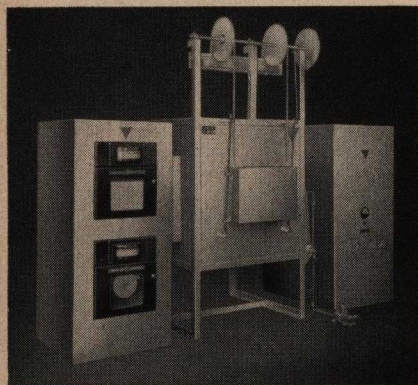
Production Kilns

This Model EX-42 Pereco Kiln firing bone china exemplifies the breadth of production work in all phases of ceramic firing now being efficiently handled with Pereco Equipment. Silicon carbide heating elements and a proper baffling system insures clean uncontaminated atmosphere and even heat distribution throughout the ware, as well as flexibility of firing schedules. Units available in many sizes and modifications.



Laboratory Kilns and Furnaces

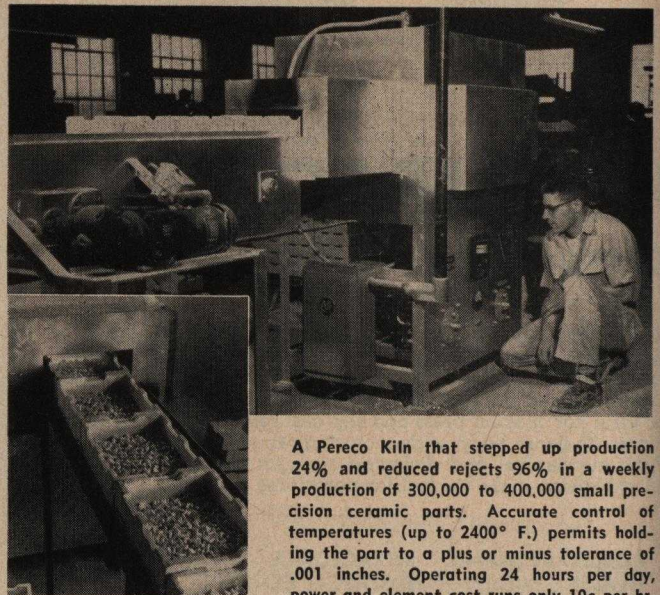
Typical of the extensive line of standard Pereco units, with a wide choice of controls, for laboratory work is this Model LB. One in a series designed for normal operation up to 2750° F. with a maximum of 3000° F. for short periods. Instruments for accurate control of time and temperature cycles are supplied built-in or mounted in separate panels.



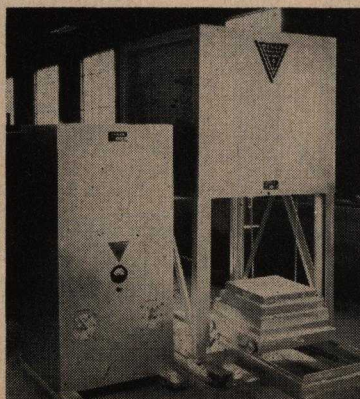
A general purpose heat treating furnace—one of several sizes in the FG Series—suited to a full range of needs, including high speed steels. Designed for continuous duty at all heat levels up to 2500° F. Optional manual or air-operated door. Available with a choice of controls and other modifications.

Pereco specializes in Electric Furnaces and Kilns for temperatures from 450° to 5000° F. This concentration on one objective assures the most modern and efficient equipment available for Ceramic and Metallurgical work. All Pereco equipment is built for tough "day in—day out" use. Its ruggedness is proved by long records of industrial and laboratory use of almost every kind. New and individual needs are also given special attention—a major reason for the fast-growing use of Pereco equipment for Ceramic and Heat-Treating problems in this country and throughout the world. Only a few standard and special Pereco Electric Kilns and Furnaces are listed on these pages. You are invited to inquire about equipment that meets your needs. Write today.

*Standard or Special Kilns or Furnaces for
Temperatures from 450° F. to 5000° F.*



A Pereco Kiln that stepped up production 24% and reduced rejects 96% in a weekly production of 300,000 to 400,000 small precision ceramic parts. Accurate control of temperatures (up to 2400° F.) permits holding the part to a plus or minus tolerance of .001 inches. Operating 24 hours per day, power and element cost runs only 10c per hr.



Pit Furnaces

Left: An inverted pit with elevating, plug type door that rolls forward for ease of handling heavy loads 2750° F.

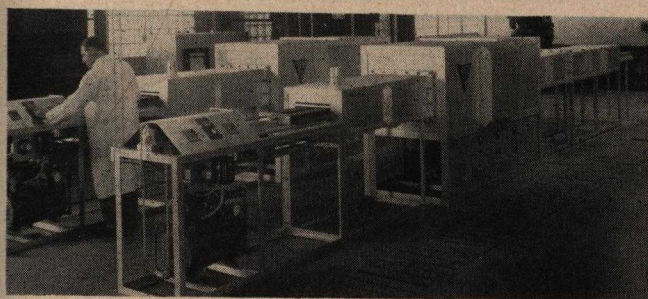
Right: A pit furnace (for temperatures to 2500° F.) with a work area of 18"x25"x42".





Sectionalized Tunnel Kilns

Another "first" by Pereco that has wide acclaim in the ceramic field is the factory-built, sectionalized electric continuous kiln. The required number of self-contained sections or zones are quickly assembled for volume production right on the job location—and just as quickly dismantled for moving or relocating. Available with belt or pusher type conveyor. Silicon carbide electric elements provide full ceramic range of accurately controlled operating temperatures up to 2600° F. Number and size of sections or zones variable to meet individual time, temperature and production requirements.

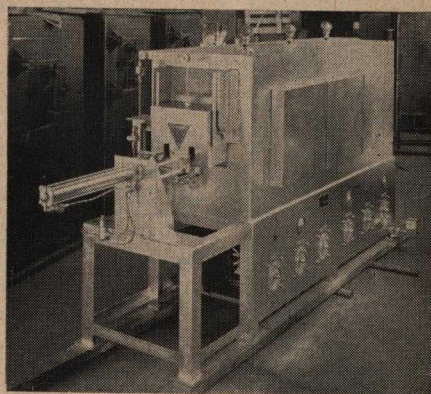


Above: A "Car" Type Furnace.

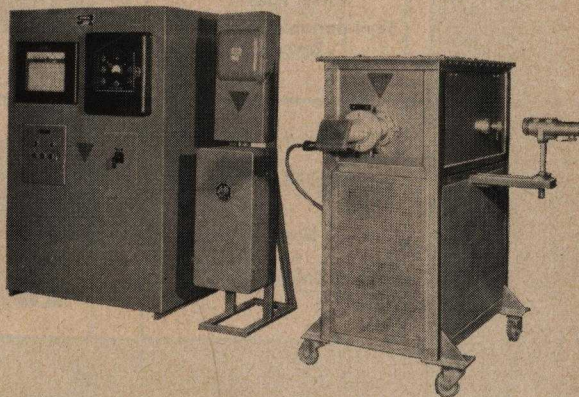
Upper Left: Two "Sliding Plate" Type Kilns.

Left: A "Belt" Type Oxide Reduction Furnace.

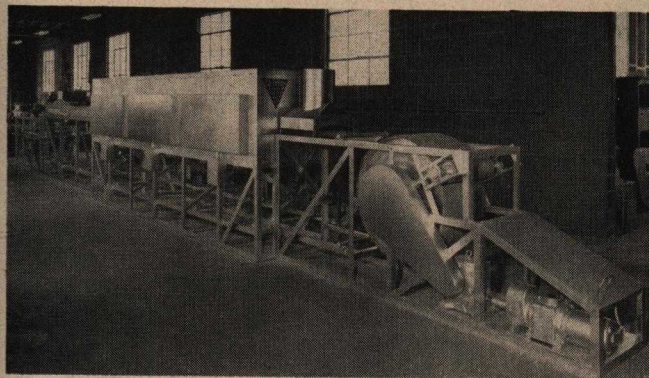
Right: A sequence timed, straight-line production furnace with foot-pedal controlled semi-automatic loading and unloading mechanism. Permits uninterrupted one man operation.



5000° F Carbon Resistor Tube Furnace

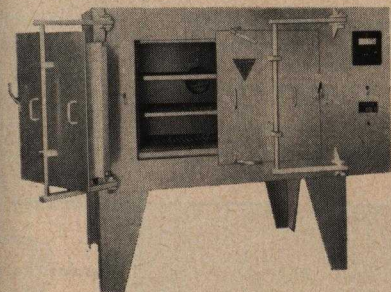


A carbon-resistor type Tube Furnace (Model CT-312) for laboratory work in metallurgy or ceramics—maintains plus or minus 20° F. up to maximum of 5000° F. Choice of heat-up rate—rapid or slow.



Ovens

Left: A high temperature (up to 1200° F.) recirculating Pereco Electric Oven particularly suited for chemical glass annealing. Completely self-contained, including removable stainless steel liner and shelves, blower and all controls, wired ready to use. Other types and size ovens also available.



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PRICES**

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ADVANCED CERAMIC

MIXING, BLENDING AND DRYING EQUIPMENT

CLAY WORKING EQUIPMENT

SIZE REDUCTION AND CLASSIFICATION EQUIPMENT

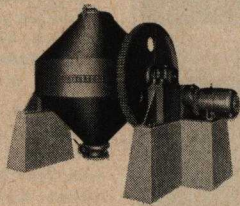
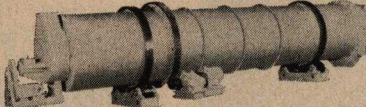
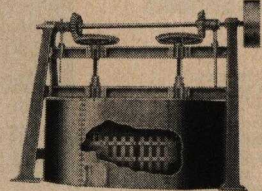
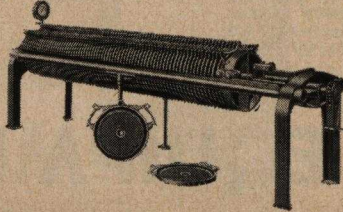
Agitators . . . Enamel Mixers . . . Storage Vessels . . . Slip
Glaze Mixers . . . Portable Mixers . . . Dry Blenders
Rotary Dryers

Blunger Mills . . . Filter Presses . . . Clay Washers . . .
Presses . . . Dust Mills . . . Slip or Glaze Pumps . . . Pug Mills
Jollies . . . Laboratory Equipment . . . Sand Grinding Pans
Tile Presses

Pebble and Ball Mills . . . Tube Mills . . . Continuous Grinding
Mills . . . Continuous Grinding Systems . . . Revolving Screens
Wet or Dry Pans . . . Crushers . . . Disintegrators
Mill Linings and Balls

MIXING BLENDING and DRYING EQUIPMENT

CLAY WORKING EQUIPMENT

EQUIPMENT	FEATURES	APPLICATION
ENAMEL MIXERS SLIP OR GLAZE MIXERS STORAGE VESSELS	 Open or vapor-tight construction Self-draining Jacketed or Unjacketed Stirrers to suit application	Efficient mixing of: casting slip ceramic colors glaze ceramic materials kinds All types of liquid materials
THORO-BLENDERS Type "B"—Standard Electrically Heated Jacketed Blenders Disintegrating Blenders Laboratory Blenders	 Homogeneous blending of dry, free-flowing materials Rapid loading and discharge Ease of cleaning Low operating cost	Blending and mixing: ceramic colors pigments minerals glass batch synthetic products all free-flowing materials
DIRECT HEAT ROTARY DRYERS Indirect Fired or Direct Fired Semi-portable Package Dryers	 Steel or alloy construction, or lined with Porox Available with either parallel or counter-flow drying 3- to 8-ft. diameter Any length desired	Widely used in drying: clays earth pigments enamel frit silicates chemicals ceramic raw materials all kinds
BLUNGER MILLS Lined or Unlined	 Single or Double Mill Construction Belt or Direct Motor Drive Rugged Construction throughout	For rapid and thorough integration of clays and other materials to produce high slip and hold in suspension
FILTER PRESSES 24 to 72 Chambers	 Standard 27-inch Press noted for its stability Plates are cast from a special alloy Heads are of rugged design, amply braced and reinforced	Popular favorites in pottery, tile, porcelain washing and processing refining plants...for dilling kaolin, clay, silica, earth pigments

Technical Bulletins on all Patterson Equipment Available on Request

DEPARTMENT OF ENDURING SATISFACTION



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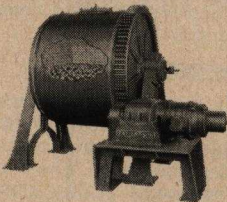
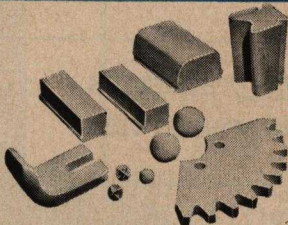
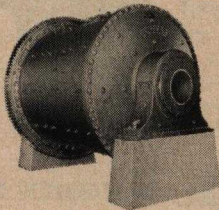
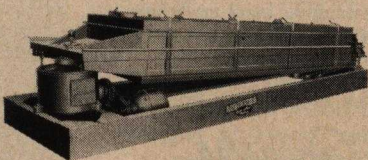
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EQUIPMENT		FEATURES	APPLICATIONS
PEBBLE and BALL MILLS Batch Type		For wet or dry grinding Lined or Unlined Jacketed or Unjacketed Floor or Ceiling Mounted Sizes: 15" x 21" to 9'6" x 12'	For grinding: ceramic bodies glaze ceramic colors clays silica feldspar, etc. For pulverizing materials of all kinds
MILL AND TANK LININGS GRINDING BALLS AND SPECIAL SHAPES POROX (Standard Density) ARLCITE (High Density)		POROX Linings and Balls are pure white, acid-resistant, strong and impervious to moisture ARLCITE—high alumina, high density mill linings and grinding balls have tough bond, grind faster, last longer	Ideal lining for mills used for grinding: ceramic materials, glaze, enamel frit, ceramic colors, etc. Arclite is used for faster grinding of coarse, hard grinding frits, quartz, silica, cement, flux for glass, etc.
CONTINUOUS GRINDING MILLS Open or Closed Circuit CONTINUOUS GRINDING SYSTEMS		For wet or dry grinding Jacketed for heating or cooling Ceramic or metallic linings Minimum contamination	For continuous grinding of: Ceramic raw materials enamel frit clays feldspar minerals slurries semi-pastes
GYRO-CENTRIC SCREENS Many Standard and Special Designs		Exact separation to close specifications Handles both wet and dry separations Controls size of ground materials One to four screening surfaces	For Dry Screening: pigments ceramic materials of all kinds For Wet Screening: clay slip enamel frit ground materials pigments

THE Patterson



FOUNDY AND MACHINE COMPANY

• A Subsidiary of Ferro Corporation •

East Liverpool, Ohio, U.S.A.

THE Patterson FOUNDRY AND MACHINE CO. (CANADA) LTD
Toronto, Canada

POSEY IRON WORKS, INC.

Brick Machinery and Mixer Division
LANCASTER, PENNSYLVANIA
New York Office: Graybar Building

Lancaster®

Equipment for Ceramics, Refractories and Mineral Processing Industries



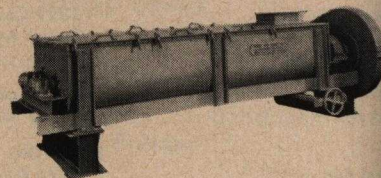
8 Sizes
30 Models
Capacities up to
4,000 Lbs. per batch

Lancaster MIXERS

Fundamentally different in design, the Lancaster Counter-Current Batch Mixing System has earned a remarkable reputation for mixing and mulling simple as well as the most difficult formulas for ceramic and other technical industries. The combination of (1) clockwise rotating pan, conveying materials into the mixing area of (2) counter-clockwise rotating plows and mullers, off-center of the pan diameter, creates a (3) balanced mixing-mulling action . . . resulting in rapid, dependably uniform mixing unapproached by less accurate methods. Sizes for laboratory and research development as well as full-scale production. Test demonstrations arranged.

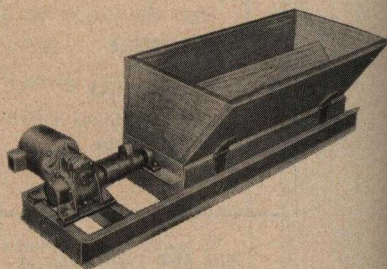
AUTOMATED MIXING EQUIPMENT

Lancaster Mixing and Conditioning Equipment may be operated automatically from a Central Panel Board Control. Manual labor is eliminated except for batch accumulation and introduction. Material transfer is completely automatic through dry sifting and blending, wetting, mixing and mulling, and granulating. The avoidance of costly human error, increased productivity and improved quality control are some of the profit-boosting benefits. Lancaster designs and furnishes the complete package to meet individual requirements.



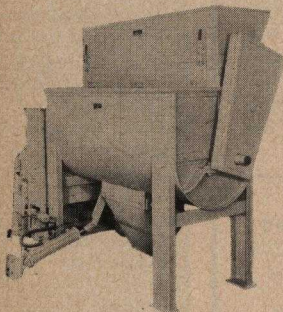
Lancaster PUG MILLS

Mix, blend, knead, temper and feed . . . continuous processing for clays, fertilizers, mineral and organic solids. Custom built single and double shaft types.



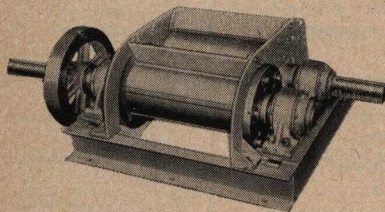
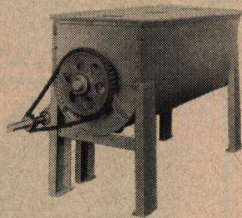
Lancaster PELLETER

New, efficient, economical method for sizing mixed bodies and improving "flowability" into the mold cavity of dry presses. Continuous dust-free operation. All parts easily accessible for quick cleaning. Requires minimum floor space and no operating attendant. Direct drive 2 hp. gear motor.



Lancaster BLENDERS or BLENDERS With SIFTERS

Developed for blending dry, pre-sized powered materials. Particularly efficient for distributing minor ingredients, colorizers, and materials of hygroscopic character. Carefully developed spiral action, plus unique flush discharge gate, assure fast, complete blending.



Lancaster CRUSHERS AND DISINTEGRATORS

Two-roll types for breaking down friable materials. Eliminate small stones and nodules; reduce materials to workable sizes. Available for the following capacities:

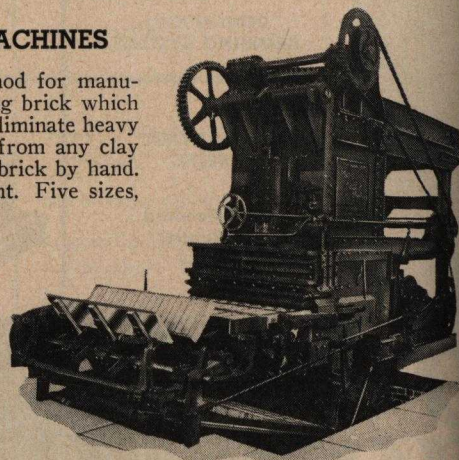
- F-18. To 25 Tons Per Hour
- F-24. To 50 Tons Per Hour
- F-30. To 75 Tons Per Hour

Lancaster AUTOBRIK MACHINES

Modern, high-production, automatic method for manufacturing sand molded, colonial type building brick which resemble the original hand made product. Eliminate heavy manual labor and assure marketable brick from any clay or shale that can be successfully made into brick by hand. Horizontal or vertical pug mill arrangement. Five sizes, with capacities up to 12,500 brick per hour.

Lancaster AUTO PALLET CAR LOADER

Designed for operation with the Lancaster Autobrik Machine. Places pallets of brick on drier-car shelves mechanically instead of manually. Increases productivity, decreases work load. Pays for itself in a year or less.



AUXILIARY BRICK PLANT EQUIPMENT

- Brick Molds
- Conveyors
- Tunnel Dryers
- Granulating Feeders

Write for Recommendations on Any Lancaster Equipment

DIVISIONS

Steel Plate Fabrication • Industrial Heating • Iroquois Asphalt Plant • Gray Iron and Steel Foundry • Tunnel and Mine Equipment

THE POTTERS SUPPLY COMPANY

Designing and Engineering Manufacturers

EAST LIVERPOOL, OHIO. U. S. A.

PINS

SAUCER

PLATE

DISH

WASH BOWL

SNAPPER

PIN-RITE®

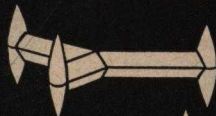
Products

KILN ROOM SUPPLIES

ENGINEERED solely for the Ceramic Industry . . . designed to meet specific needs of Tableware, Tile, Insulator, Steatite, Sanitary, Novelty, Art and Specialty manufacturers . . . for over 65 years, the standard by which "Quality" in Kiln Room Requisites is measured.

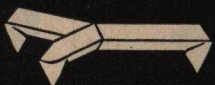
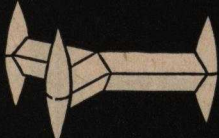
PROVED FORMULA is the "key" to PIN-RITE Strength, Uniformity, Reliability . . . formula, plus highest grade Tested Materials, Scientific Processing, Precision-Forming and automatic Thermal Control in drying and firing.

STILTS



REGULAR

BULL DOG



SINGLE POINT

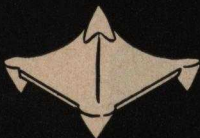
FRUIT TYPE



SPURS



DECORATING



REGULAR

THIMBLES

SQUARE



ROUND



FULL LINE OF PINS

PIN-RITE Pins are offered in a complete range of standard lengths in 4 common types . . . Saucer Type (4 cross-sectional sizes), Plate Type (4 sizes), Dish Type (3 sizes) and Wash Bowl Type. Also available, is the Special Snapper Type Pin (2 sizes) and Twin Snapper Type Pin (2 sizes).

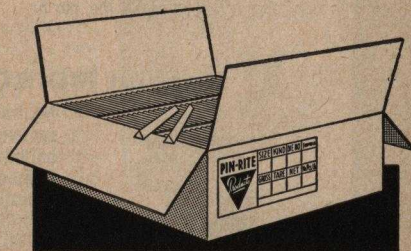
THE P-38 FORMULA

All pins can also be furnished in the popular P-38 Formula, an exclusive PIN-RITE body-mix. This soft, structurally rugged body was formulated primarily to minimize pin markings . . . also reduces dressing time, eliminates pullouts. Is particularly ideal for placing Color-Glazed ware.

CARTON PAK

Sealed
Cuts Costs

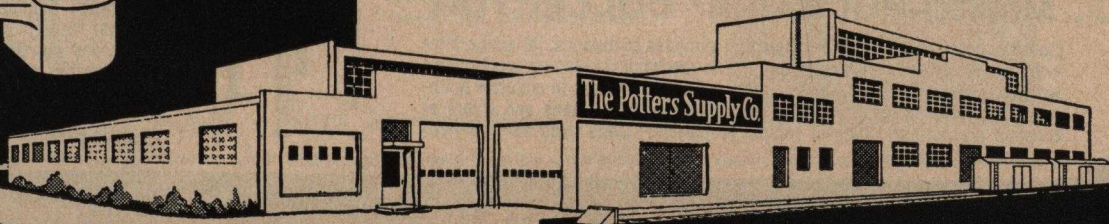
Eliminates waste and waste motion in Ware Placing. PIN-RITE Pins come in convenient Carton packages, clean packed and aligned in rows, ready for use. No sorting or throwaways. Also (if desired), the sturdy New Fiber Drum packing is available on large orders.



OTHER PIN-RITE PRODUCTS

Included are STILTS (Regular, Bull Dog, Single Point, Fruit), SPURS (Regular and Decorating) and THIMBLES. All standard sizes.

SPECIAL SERVICES. Extensive tool equipment is maintained to produce a varied assortment of Pin & Placing Specialties . . . including designs of round, square, oval, rectangle or irregular cross-sections . . . also Peg Setters, Tile Pins & Setters and specialties for Porcelain-Steatite placing. Prices on request.



SERVING THE CERAMIC INDUSTRY SINCE 1891

PULVERIZING MACHINERY DIVISION

METALS DISINTEGRATING COMPANY, INC.

Manufacturers of Pulverizers, Air Conveying and Dust Collection Equipment

65 Chatham Road

Mikro-D

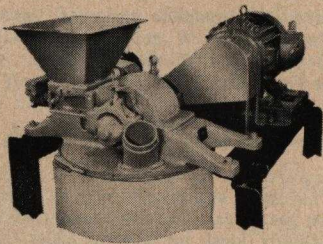
Summit, New Jersey

MIKRO-PULVERIZERS

*Units for efficient and economical grinding of clays,
earths, raw or calcined gypsum and gypsite, steatite,
ceramic oxide colors and glazes, and grinding wheel bonds.*

THE MIKRO-PULVERIZER

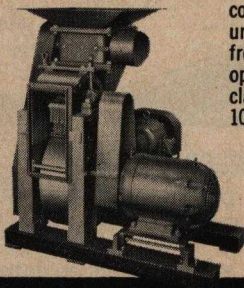
Engineered for precise particle control, with higher production at lower cost. Reduced grinding temperatures make it ideal for processing of heat-sensitive materials. Grinds and blends in single, dustless operation. Available in six sizes for both wet and dry grinding. Capacities from 5 to 30,000 lbs. per hour. Bulletin 51A.



NO. 3TH MIKRO-PULVERIZER ...
Capacities to 15,000 lbs. per hr.

Special MIKRO-PULVERIZERS

No. 1 and No. 2SP for plastic clay bodies containing up to 25% moisture. Produce uniform 12 to 16 mesh granulations from dry process clay bodies in one operation . . . without auxiliaries or classifiers. Capacities from 500 to 10,000 lbs. per hour. Bulletin 51A.

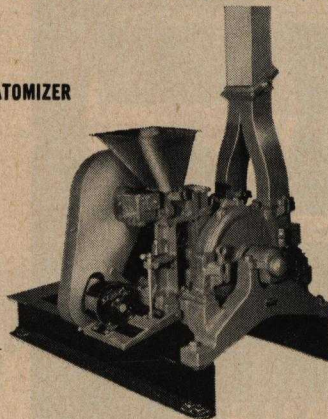


NO. 2SP MIKRO-PULVERIZER

THE MIKRO-ATOMIZER

A 3-functional mill that pulverizes, air classifies and conveys material in one operation. Cool, highly compact, it eliminates air conveyor, bucket elevator and screw conveyor. It is a mechanical, screenless pulverizer for production of smooth, ultrafine powders in the 1-25 micron range. Bulletin 51G.

NO. 6 MIKRO-ATOMIZER

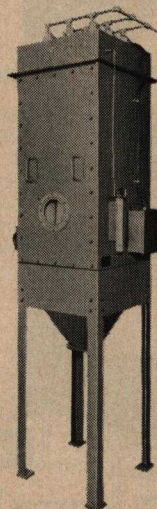


FOR HIGHEST, EFFICIENT DUST RECOVERY THE ALL-NEW JET-ACTION MIKRO-PULSAIRE* COLLECTOR

Operates on a radically new principle that provides continuous, jet-action filter cleaning. No internal moving parts . . . no mechanical cleaning mechanisms with their gears, cams, or chains . . . the most costly factors in collector maintenance completely eliminated! A simplified unit that cleans and filters at constant pressure and highest volume efficiencies! Units sized for every requirement. Bulletin 52A.

*Patents applied for

MODEL 9-6
PULSAIRE COLLECTOR



MIKRO-COLLECTOR.

Standard of the reverse jet-ring type collectors! Handles widest range of dusts and powders . . . provides maximum recovery of valuable products. Bulletin 52B.

TEST GRINDS OR FILTRATION TESTS—Complete pulverizing and dust collection research laboratories and test grinding facilities available without obligation.

RAM* INCORPORATED

1064 West Fifth Avenue, Columbus 8, Ohio, Phone AX 1-0459

RAM Process Increases Output and Quality: Lowers Unit Cost

The Ram Process is the mechanical plastic pressing of ceramic shapes in gypsum-cement dies . . . permitting instant release of the formed piece by the application of fluid pressure through the permeable die.

At right is shown the step-by-step procedure of the Ram Process. This particular operation is with a multiple cavity die working on the self-scraping principle. Up to 6,000 pieces per eight-hour day can be produced by this method with only two operators.

Other plus features of the Ram Process are a decrease in rejects, improved product appearance, reduced floor space requirements, elimination of large mold inventories, and reduction of the product unit cost. Appendages such as handles can be pressed directly on many pieces.

Ram Process is flexible, versatile

Pieces having extreme variations in thickness and asymmetrical as well as symmetrical pieces, are readily formed. Short demand orders can be finished quickly and production units can be converted to produce other shapes in a very short time.

Dies are simple, inexpensive

Die-use cost is at the most on a par with mold-use cost and is often greatly less. Die life ranges from 1,000 to 5,000 pressing cycles — averaging about 2,500 pressings. Replacement of Ram Dies is easy, quick . . . approximately one man-hour is required.

Ideal Ram Process Applications

The Ram Process is applicable to the manufacture of hotel china, vitrified, semi-vitreous and informal dinnerware; electrical, chemical and industrial porcelain; quarry tile, glazed tile, glazed brick and refractory shapes; artware and novelties; and sanitary ware.



Ram Incorporated

California Agency: Jae of California, 6831 San Fernando Rd., Glendale, Calif.

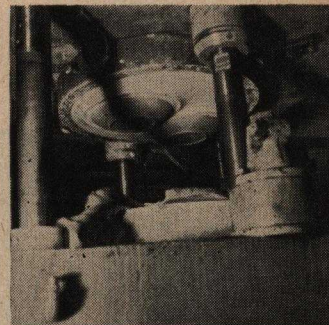
1. Operator places clay charge on lower die member. Die is then closed.



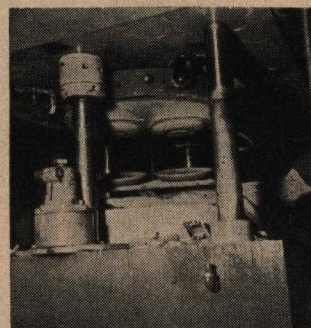
2. While die is closed, lower die member is pressurized by use of compressed air.



3. Pressurizing releases ware from lower die member. Ware adheres to upper die member when die is opened.



4. Top die member is then pressurized, releasing ware into operator's hands.



ORIGINATORS AND DEVELOPERS OF THE RAM PROCESS FOR PLASTIC PRESSING

*Registered U. S. Trademark

Patented Process

RICHARD C. REMMEY SON CO.

Subsidiary of A. P. Green Fire Brick Co.

Philadelphia 37, Pa.

REMMEY

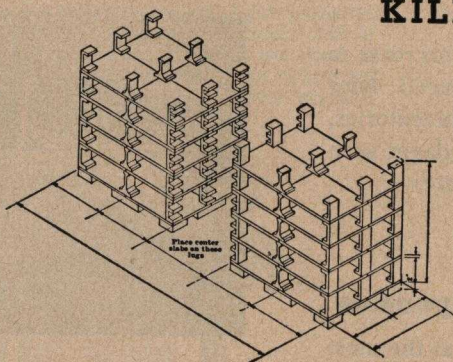
Dependable Refractories

- Silicon Carbide
- 99½% Alumina
- Mullite (Crystalite)
- Hotspan

- 90% Alumina
- Zircon
- Fire Clay
- Semisilica

Slabs—Posts—Beams—Kiln Car Blocks—Cements—Bricks—Special Shapes—Burner Blocks—Muffle Tiles

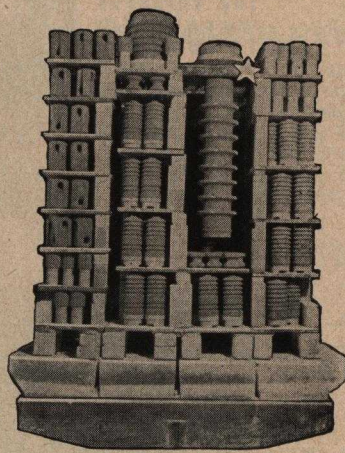
KILN FURNITURE



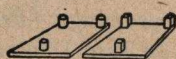
Kiln Slabs and Saggars—Remmey is noted for its many years of experience and success in producing top quality Grade "A" silicon carbide kiln furniture.

Mullite, 90% and 99% alumina kiln furniture are also available for special operating conditions.

Posts—See schematic diagram for T, U and E posts. These posts made 5¾" to 23" high. Fire clay posts—see illustrations for rectangular, lug type, angle I, T, U and E posts and sagger set cars. Rectangular clay posts can usually be shipped from stock.



Knockdown Assembly



Three posts on each slab. Each slab supported on three posts. Usually used with small posts for small ware.

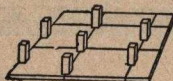
BEAMS

Made in lengths up to 48".

Note: Beam 1½" x 2" shown at left supporting heavy insulators.



Posts are used to interlock slabs into rows but not interlocking cross rows.



The minimum number of posts are used here, completely interlocking the slabs.

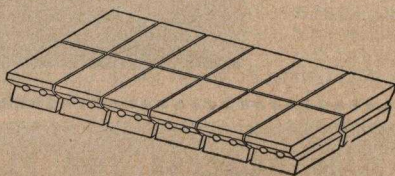
KNOCKDOWN SETTINGS

Slabs and posts arranged to suit your production. They are taken down quickly after each firing and reset to suit particular ware to be fired. See illustration at left.

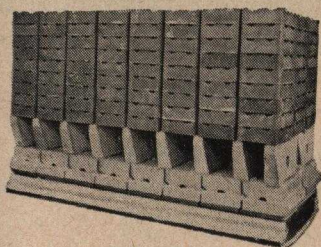
REMMEY CAR BLOCKS

These blocks are unique in design—only two different shapes (3 in wide kilns) being all that is necessary for a complete car top. Manufactured from a Remmey Clay Body, engineered to give greater resistance to load and spalling. Easy to install with unskilled workers. Easy to clean kiln dirt. See line drawing on left.

Remmey Car Blocks also available in Mullite and Silicon Carbide Brands.

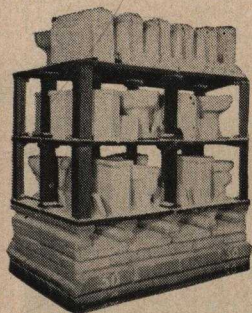
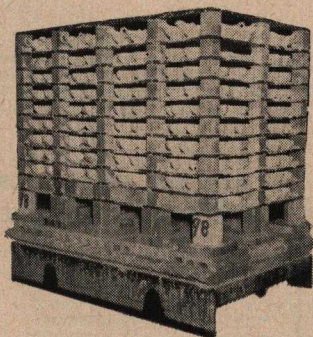


RICHARD C. REMMEY SON CO.



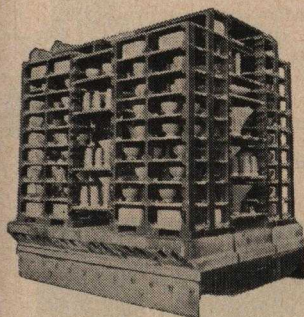
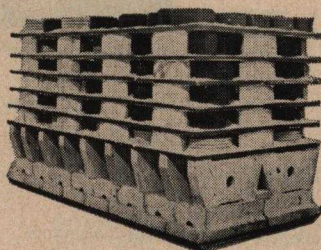
SAGGER SET CAR

CHINA WARE



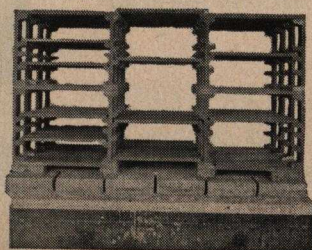
SANITARY WARE

GRINDING WHEELS



PORCELAIN
INSULATORS

FOR SHORT
OR TALL WARE



RM BRAND SEMISILICA BRICK



For tunnel and periodic kiln construction. Some tunnel kilns lined with RM's are still in service after twenty years. In periodic kiln bottoms, crowns, and arches, RM bears the load and pressure without sagging or spalling.

RM should be used in furnaces operating continuously enough to cause "first quality" and "super duty" brick to vitrify and spall . . . yet which are shut down frequently enough to cause silica brick to spall.

PCE does not indicate resistance to shrinkage, deformation or vitrification. It takes prolonged heats to determine resistance to these actions. RM bricks are noted for their long trouble-free service.

PROPERTIES

Silica content 76-77%. Alumina content approx. 20%. High resistance to structural spalling. Resistance to load at high temperatures. PCE Cone 28. Reversible thermal expansion about .076%. Allowance for reversible and permanent expansion in wall construction should be about 1.5%. Weight, 6¾ lbs. each.

MUL-8 BRAND MULLITE BRICK

P.C.E.—Cone 38+

Mul-8 is a crystalline mullite refractory. Low in price, it offers an excellent value for a crystalline mullite refractory.

Modulus of Rupture—2596 p.s.i.

Cold Crushing Strength—9000+ p.s.i.

Bulk Density—2.45

Apparent Porosity—21%

Apparent Specific Gravity—3.03

Slag Resistance—High, because of high mullite content, except when slag composition is extremely acid or basic.

Approx. weight—8½ lbs. (9" straight brick).

Available in the following forms:
Standard Brick & Special Shapes.



CRYSTALITE "L" BRAND MULLITE INSULATING BRICK

P.C.E.—Cone 39-40

Crystalite "L" refractories are made of crystalite grain bonded with mullite producing bond.



Reheat Tests held at 4 hours:

Shrinkage—0.0% at 3000°F.

Shrinkage—0.38% at 3200°F.

Cold Crushing Strength—1100-1200 p.s.i.

Structure—highly crystalline.

K Factor of 4.75 at 2200°F.

Weight: 5-5¼ lbs. (9" straight brick)

Available in following forms: 9x4½x
2½" straights & special sizes made on
order.

RICHARD C. REMMEY SON CO.

Subsidiary of A. P. Green Fire Brick Co.

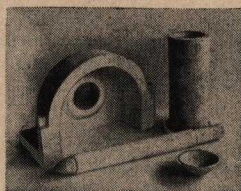
CRYSTALITE —THE HIGH PURITY MULLITE MADE BY . . . REMMEY

Research proved "A uniform, high purity mullite could be made" if equipment could be built to fire the pure ingredients high enough to convert them into crystalline form.

CRYSTALITE CRUDE is the name of this uniform high quality mullite grain produced by these facilities.



CRYSTALITE A & CRYSTALITE are the brands of the finished refractories.



SEND FOR BULLETIN CR-11 titled **CRYSTALITE THE IMPROVED MULLITE**

PROPERTIES

Weight per 9" brick
Fired to
PCE
Alumina Content
Load Test 3100° F. 25 lbs. psi subsidence
Load Test 2640° F. 25 lbs. psi subsidence
Reheat Test 3300° F. shrinkage
Modulus of Rupture ASTM—C133-49
Apparent Porosity
Apparent Specific Gravity
Structural Spalling Resistance
Thermal Spalling Resistance
Slag Resistance

CRYSTALITE A CRYSTALITE

9 lbs.	8.8 lbs.
Cone 35	Cone 18
Cone 39-40	Cone 39-40
76%	74%
0.2%	-1.8%
0	0
0.03%	0.44%
2815 lbs.	1610 lbs
19.8%	22.7%
3.12	3.12
excellent	excellent
fair	excellent
excellent	good

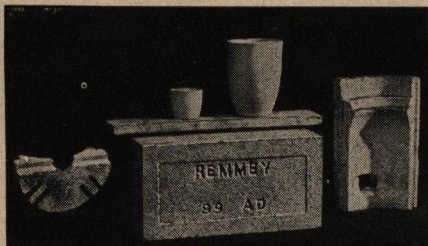


USES

Refractories for Glass Melting—Forehearths, Feeder Parts, Checkers and Superstructure.

Available in standard and special shapes.

99AD REFRACTORIES



PCE Cone 42. Fired to Cone 35.
Made of Pure White chemically precipitated Alumina.
Bonded by high firing without clay or glassy bond.
Contains over 99% Corundum. (Crystalline form of Alumina.)
Modulus of Rupture—3600 psi.
Load Test—At 2950° F.—25 psi subsidence less than 0.5%
Shrinkage—4 hrs. at 3500° F.—less than 0.8%
Weight 10½ lbs. per hundred cubic inches.

Slag Resistance—99AD is nearly 100% Crystalline, so rate solution in contact with some highly corrosive slags is negligible.

Furnace temperatures over 3500° F.—99AD may be used in temperature range approximately that of pure Corundum.

ZIRCON REFRACTORIES

Compounded of selected grades of refined zirconium-silicate ($ZrSiO_4$) sintered at high temperatures. They possess uniformly dense structure and high mechanical strength. Analysis (approximate)—64.30 Zirconium Oxide.

35.18 Silica

Weight—9" x 4½" x 2½" brick, approximately 12¼ lbs.

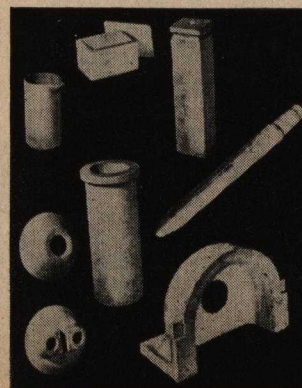
PCE—Above Cone 42.

Apparent Porosity—25-27%.

Specific Gravity—4.62-4.57

Slag Resistance—Highly resistant to acid slags; boro-silicate glass; copper; copper alloys; aluminum; platinum; and some enamel frits. NOT recommended for use where basic oxides are present.

AVAILABLE in following forms: standard bricks; crucibles, glass feeder parts, pyrometer tubes, tile nozzles for pouring copper, ramming cements for ferrous furnaces, air and heat-setting mortars. Special shapes to specifications.

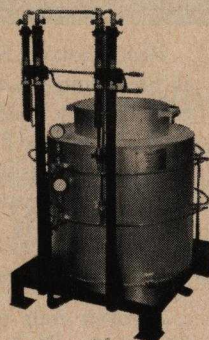


RICHARD C. REMMEY SON CO.

FURNACE DEPARTMENT

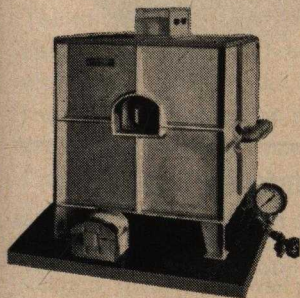
KILN No. 6800

Setting Space—7" diameter x 8" high.
 Overall Dimensions—35" x 43" x 57" high.
 Type—Top loading.
 Fuel—oxygen and propane with low pressure air as supplement to oxygen.
 Fuel Control—By flowmeters.
 Burners—4 water cooled, tangential.
 Temperature Range—To 3500° F. in 6½ hrs.
 Stack—None required.
 Because oxygen is used, the cost of this kiln is less than those using preheated air. It has become a popular model for anyone interested in obtaining good equipment for temperatures to 3500° F. at minimum cost.



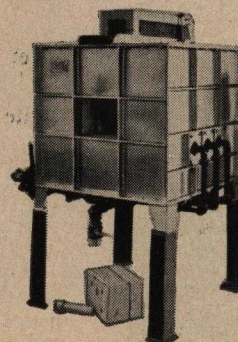
LABORATORY KILN No. 2150

Setting Space—4½" x 6½" x 4".
 Overall Dimensions—Approximately 30" x 30" x 30".
 Type—Gas-fired, semi-muffle. Can be quickly converted to full muffle.
 Stack—None required.
 Fuel—Propane, natural or city gas.
 Temperature Range—1200° F. to 3100° F.
 Maximum Gas Consumption—110,000 BTU per hour.
 Air Requirements—50 cu. ft. per minute at 12 oz. pressure.
 When supplied for compressed air—3½ cu. ft. per minute at 50 lb. pressure.
 Opens the field of extra-high temperatures to every laboratory.



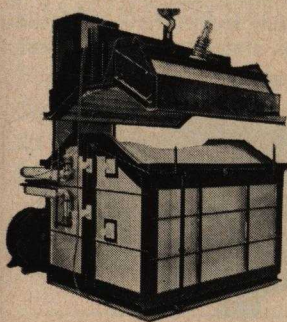
KILN No. 2320—6 BURNERS

Setting Space—12" x 18" x 9" high.
 Overall Dimensions—Approximately 4' x 4' x 6'.
 Type—Gas-fired, semi-muffle, single valve control.
 Stack—Not necessary, but desirable to keep atmosphere and temperature comfortable.
 Fuel—Propane, natural or city gas.
 Temperature Range—to 3200° F.
 Refractories—Crystallite A and light weight mullite, heavily insulated.
 Can also be supplied with 8 burners, 24½" x 12" x 9" setting space.



KILN No. 6600-35

Construction—Roll-away roof design
 (1) All refractories supported by steelwork for low maintenance
 (2) Easy to load and unload
 Setting Space—20" wide x 34" long x 22" high
 Floor Space—8' wide x 11' long x 10' high
 Type—Preheated air via metallic heat exchanger, includes exhaust fan
 Stack—None required (6" diameter 20 gauge sheet steel exhaust pipe can be used to conduct 700° F max. products of combustion to outdoors)
 Fuel—Propane, natural or manufactured gas
 Fuel Control—Gas, primary air and preheated air all controlled by flowmeters. Top burners and bottom burners separately controlled.
 Air Requirements—185 cu. ft. per minute at 20 oz. pressure
 Burners—4 specially designed nozzle mix preheater air type
 Temperature Range—to 3500° F
 OTHER MODEL 6600 KILNS
 6600-33 24" x 38" x 22" high, temperatures to 3330° F
 6600-32 28" x 42" x 22" high, temperatures to 3200° F
 6600-29 36" x 50" x 22" high, temperatures to 2900° F
 *Preheater not required, exhaust through refractory stack.



For further information, write:

RICHARD C. REMMEY SON COMPANY
 Philadelphia 37, Pennsylvania

SALES OFFICES

BIRMINGHAM, ALA.
 BUFFALO, N. Y.
 CAMBRIDGE, MASS.
 CANTON, OHIO
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ST. LOUIS, MO.

REMMEY



REFRACTORY & INSULATION CORP.

120 WALL STREET, NEW YORK 5, N. Y.

Plant: PORT KENNEDY, PA.

Chicago 4, Ill.
Cleveland 15, O.

Newark 2, N. J.
Bryn Mawr, Pa.
Buffalo, N. Y.

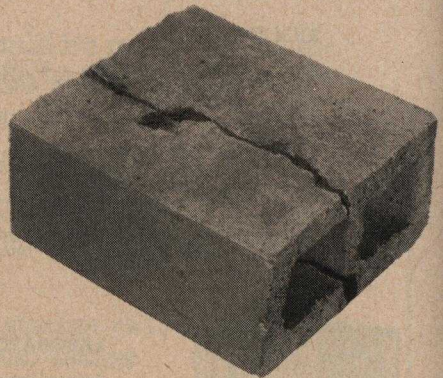


Ready mixed Super #3000 refractory bonding mortar is the strongest, most durable mortar ever developed, as evidenced by hundreds of success stories.

It outlasts the firebrick or tile it bonds, giving refractory service previously thought impossible in a bonding mortar.

At all temperatures to 3000°F. it is remarkable for its bonding strength, erosion, abrasion and spall resistance.

Broken ends of car top tile are buttered with Super #3000 and pressed together. When mortar has set, tile is as good as new.



SERVICE DATA

Base—High alumina.

Maximum Temperature—3000°F. (no water cooling).

*Pyrometric Cone Equivalent—C/33-3175°F. Melting Point.

Bonding Strength—1155 p.s.i. ASTM Spec. C-198.

Moisture Loss on Drying—16.5%.

Refractoriness—Passes ASTM Specifications C-178 for Super Duty Grade at 2910°F.

Net Weight as Shipped—200 lbs. and 100 lbs. in steel drums.

*Refractories Institute Report

FURNACE BLOK*

For Monolithic Refractory Walls and Arches Without Forms

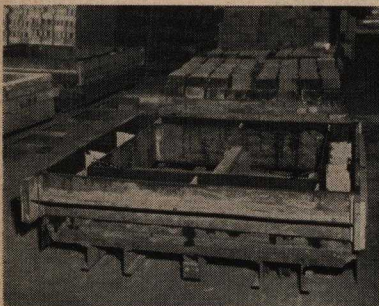
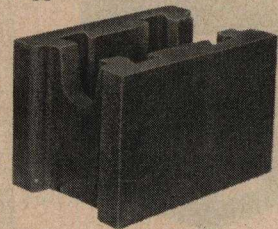
Furnace Blok is a preformed refractory building unit made of Moldit Castable. When these Blok are laid and filled with additional castable, a monolithic structure is formed. No wooden form work is necessary as with other types of monolithic construction.

A single Furnace Blok replaces 11 or 16 standard firebrick at only a small fraction of the labor and time requirement.

A jointless wall of filled Furnace Blok has all the advantages of Moldit refractory construction: superior insulating value; high resistance to spalling; low heat storage.

Standard Furnace Blok is available in two sizes: 9"x9"x13½" and 9"x13½"x13½". Many compositions, covering a wide range of working temperatures, are available.

*Patent applied for.



Simple wooden forms for pouring sections of Moldit Pier rim block are set on the car top.

MOLDIT PIER Castable Refractory

Moldit Pier is a uniform, dry granular, aluminosilicate base refractory. It is mixed with clean water right on the job, and poured, troweled or gunned in place. Used as a replacement for firebrick in the rim portion of car tops, it has been known to increase car top life as much as 150%.

Rim block sections made of Moldit Pier have two other important advantages over firebrick:

- No chance for chips of red brick to work into firebrick joints and push the firebrick outward where they can cause damage to kiln wall.
- Eliminate the laborious job of replacing broken rim firebrick. It is a simple matter to remove a Moldit Pier section, replace the wooden forms and pour a new section.



Completed car top showing monolithic Moldit Pier rim block sections. Center of car top is made up of courses of red brick with a layer of castable finished flush with the top of the Moldit Pier rim block.

R&I Moldit Castable Refractories cover a wide range of temperature, strength and weight requirements

PRODUCT	TOP WORKING TEMPERATURE	INSTALLED WEIGHT (lbs.)	SPECIAL PROPERTIES	PACKING
MOLDIT PIER	2400°F.	108	High Strength.	100-lb. bag
HOT TOP MOLDIT	2600°F.	120	Excellent Resistance to Thermal Shock.	100-lb. bag
MOLDIT D	2400°F.	115	Strongest of the Moldits. No firing shrinkage.	100-lb. bag
SUPER MOLDIT	2800°F.	108	Crushing Strength Increases at Temperatures over 2100°F.	100-lb. bag
MOLDIT HT	2900°F.	120	Excellent Spall Resistance. Used instead of super duty firebrick.	100-lb. bag
MOLDIT B	2400°F.	110	Plastic mass excellent for large patching jobs.	100-lb. bag
LW MOLDIT #80	2300°F.	80	Lightweight castable; excellent insulating value.	100-lb. bag
LW MOLDIT #58	2200°F.	58	Same as LW Moldit #80 only lighter.	100-lb. bag
LW MOLDIT #35	2000°F.	35	Very light. Excellent combustion refractory fill and seal.	40-lb. bag
RICAST	2700°F.	112	Economically priced castable.	100-lb. bag

RICHARDS-WILCOX MFG. CO.

2176 THIRD STREET • AURORA, ILLINOIS

R-W OVERHEAD CONVEYING SYSTEMS



OVERHEAD AUTOMATIC DISPATCH SYSTEMS

The unique R-W "TWIN-TRAK" System consists of one or more power tracks and as many storage or free tracks as desired. Provides trouble-free, automatic selective control over product movement through an entire plant. Products may be kept in storage banks and automatically released to work stations as they are required. Economical to install and maintain . . . extremely flexible . . . may be easily revised to meet changing needs or expansion plans.

R-W "Zig-Zag"

CONTINUOUS POWER CONVEYORS

R-W "Zig-Zag" Conveyors efficiently utilize valuable overhead space to provide a continuous flow of materials for maximum production. Extremely flexible . . . easily move up, down, in, out and around . . . carry unit loads up to 125 lbs. at speeds from one inch to 100 feet per minute . . . may be quickly and easily altered, expanded or relocated by plant personnel. Economical to purchase, install and maintain.

R-W "460"

LIGHTWEIGHT CONTINUOUS POWER CONVEYORS

R-W No. 460 Conveyor is a packaged conveyor system that was specifically designed for light loads up to 17 lbs. per lineal foot. Available in 200 foot maximum lengths with a 200 lb. draw bar pull. Requires no special installation engineering . . . quickly and easily installed.

R-W



MONORAIL SYSTEMS

Modernize production operations and reduce handling costs with an R-W "TRU-TRED" Monorail Conveyor System. Whatever your problem, from the lightest of loads up to 4 ton capacity, for manual or high speed electric operations, R-W "TRU-TRED" Track will meet your exact requirements.

The photograph, below, is an R-W installation in the Haeger Pottery Company, Dundee, Illinois. This overhead "TRU-TRED" system is used to transport ceramic pottery from one operation to another.



Richards-Wilcox, for over 78 years a leader in its field, has always endeavored to produce products that meet the highest standards of quality and craftsmanship. Included in the line of R-W "Quality" products are:

- HEAVY DUTY HARDWARE FOR INDUSTRIAL DOOR AND FIRE DOOR INSTALLATIONS
- INDUSTRIAL DOORS
- HEAVY DUTY ELECTRIC OPERATORS
- TRAVELING CRANES
- FIRE DOORS
- I-BEAM TROLLEYS

WRITE TODAY for complete information



2176 W. Third Street, Aurora, Illinois • Branches in Principal Cities

ROBINSON VENTILATING CO.

96 HENDERSON STREET • ZELIENOPLE, PENNA.

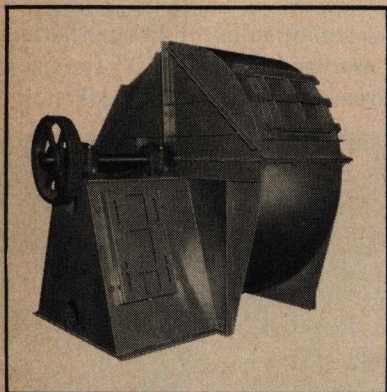
ROBINSON FANS, BLOWERS and EXHAUSTERS MEET EXACTING REQUIREMENTS OF THE CERAMIC INDUSTRY

Robinson air handling equipment for the ceramic industry is custom-engineered to meet the specific requirements designed into your tunnel kiln, periodic kiln, or product dryer. In glass plants, this engineering is applied to the problems of block cooling, machine, and man cooling. Further, the services of Robinson's experienced engineers are available for designing dryer systems as well as systems for ventilation and exhaust.

Any Robinson unit may be fabricated using selec-

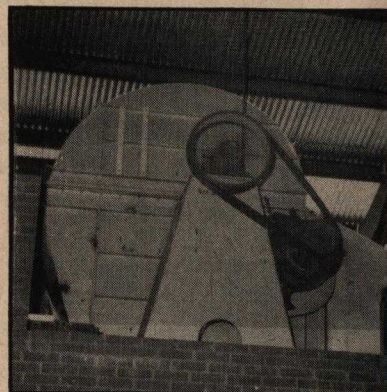
ted alloys or special materials and insulations, to provide superior efficiency and service in conditions of erosion, abrasion, and elevated temperatures. A complete range of optional equipment includes multi-leaf radial-type inlet and outlet dampers, screens, guards, bases, inspection doors, etc.

Robinson wheel and blade designs have been proved by extensive field experience, and each fan, blower, and exhauster is thoroughly laboratory tested before shipment.



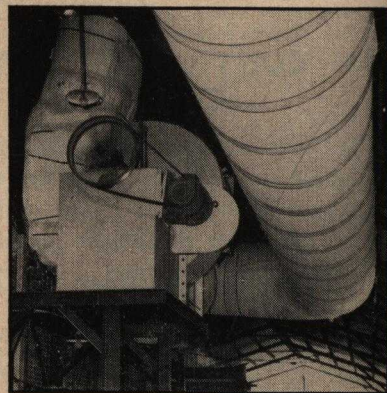
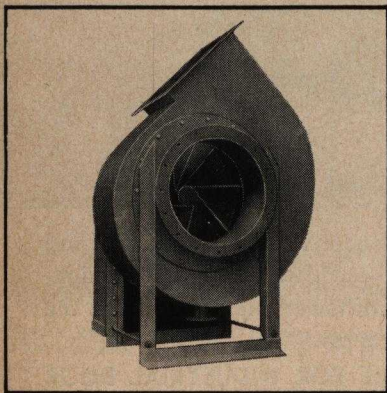
TYPE "J" FAN

This backward curve, non-overloading fan delivers high air volumes at moderate pressures. It is of heavy-duty construction, may be built in a variety of arrangements for recirculating air in kilns and dryers, exhausting heated air, and to force draft. Either direct or V-belt driven, its operation is unusually quiet, and power consumption is low. Volumes range from 600 to 450,000 cfm, pressures from $\frac{1}{4}$ " to 16" water. Ask for Bulletin 2500



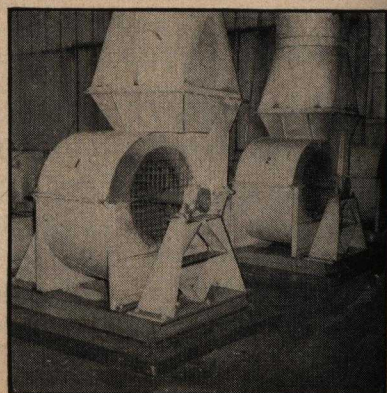
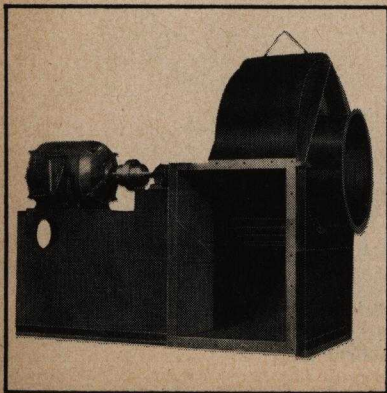
TYPE "AE-6-BB" EXHAUST FAN

The AE heavy duty exhauster handles air in moderate volumes at moderate to high pressures. It is built in a variety of arrangements for moving dust and other fine materials, and for use in high temperature exhaust, and recirculating systems in kilns and dryers. Casing may be rotated for different discharge positions; drive may be V-belt or direct. Volumes range from 400 to 90,000 cfm, pressures from $\frac{1}{2}$ " to 25" water. Bulletin 5100



TYPE "H" BACKWARD CURVE FAN

The Robinson Type "H" backward curve, non-overloading fan delivers high air volumes at moderate to high pressures. It may be built in a number of arrangements, for block-cooling, shadow-wall cooling, machine cooling, and for exhausting or blowing. It may be supplied with wheels of various widths, giving it the flexibility to handle a broad range of air volumes. Drive is either V-belt or direct. Volumes are from 100 cfm to 500,000 cfm, pressures from $\frac{1}{8}$ " to 20" water. Bulletins 2101 and 3202



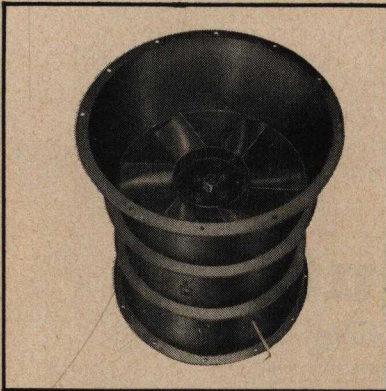
ROBINSON

HI-DRAFT FANS

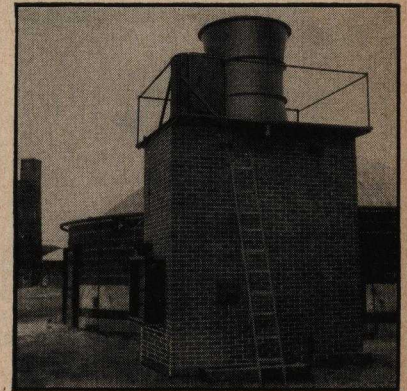
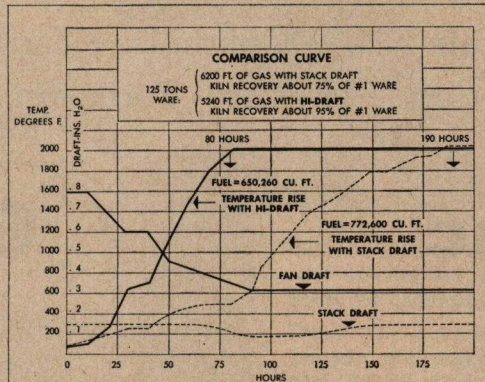
**FOR MORE EFFICIENT PRODUCTION—GREATER TONNAGE—
LOWER FUEL COSTS, WITH A MINIMUM OF CASH OUTLAY**

Robinson propeller-type Hi-Draft fans handle large air volumes at moderate pressures. They are completely self-contained units, ready for installation in duct or stack, for the purposes of (a) bringing the

kiln to firing temperature quickly, (b) faster cooling. Turnover of ware is accelerated, and fuel consumption is lower, as shown in the chart below.



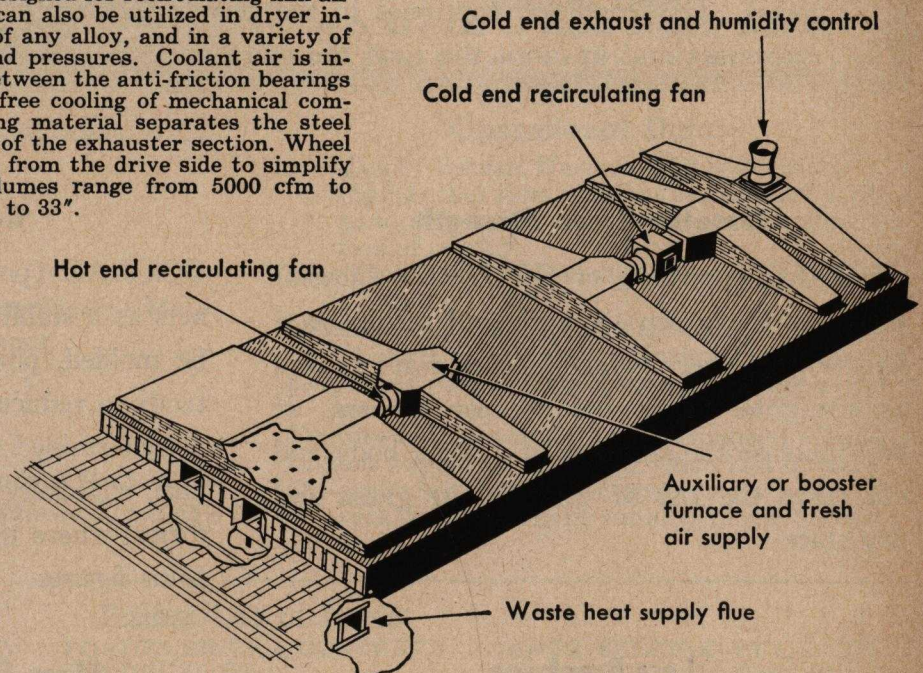
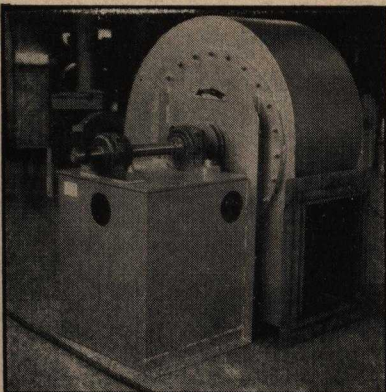
COMPARISON CURVE



HIGH TEMPERATURE AND DRYER FANS

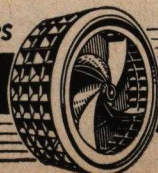
FOR RECIRCULATING AND EXHAUSTING SYSTEMS ON KILNS AND DRYERS

Robinson Hi-Temperature Fans are designed for recirculating kiln air at temperatures up to 1650°F., and can also be utilized in dryer installations. They may be fabricated of any alloy, and in a variety of design arrangements, air volumes, and pressures. Coolant air is induced through splined brass sleeve between the anti-friction bearings and the shaft, for constant, trouble-free cooling of mechanical components. High temperature insulating material separates the steel outer skin and the alloy inner casing of the exhauster section. Wheel is of the cartridge type, is removable from the drive side to simplify inspection and maintenance. Air volumes range from 5000 cfm to 15,000 cfm, wheel diameters from 24" to 33".



INDUSTRIAL FANS • BLOWERS • EXHAUSTERS

ROBINSON



VENTILATING CO.

96 HENDERSON STREET, ZELIENOPLE, PA.

ROBESON PROCESS COMPANY

P. O. BOX 960

ERIE, PA.

ORGANIC BINDERS

For

Refractories—Sewer Pipe—Bricks
Drain Tile — Conduits — Saggers
Pottery—Electrical Porcelain, etc.

Goulac

(Powder)

Glutrin

(Liquid)

Advantages

GOULAC (powder) or GLUTRIN (liquid) when added to the clay batch or mix in proper quantity immediately unites the clay particles, forming a homogeneous mass. This condition continues in the clay body through the drying and forming processes and up until the time the ware is fired.

Greater Green Strength

GOULAC (powder) or GLUTRIN (liquid) increases the green strength and results in a harder, smoother-surface finished ware as well as straighter edges and sharper corners. It will increase the strength of a weak body and cut down the loss of ware in the green and dry state.

Less Breakage

As a result of greater green strength in the burned ware, there is of course less breakage in the finished and salable ware, thus cutting losses to a minimum.

Reduces Shrinkage

GOULAC (powder) or GLUTRIN (liquid) acts as a stabilizer in the clay body whether it be molded, poured or cut shapes. Its action tends to reduce shrinkage and helps to hold to predetermined dimensions. This is very valuable, especially in the manufacture of refractories, where tolerances are held down to blue print figures.

More Plasticity in Clay Body

No aging and storing of clays is necessary to increase plasticity. By using GOULAC (powder) or GLUTRIN (liquid) you can do away with this expense.

ROCKFACER CO.

P. O. Box 547

• 503 Hickory Tree Rd.

• MESQUITE, TEXAS

• Telephone ATLantic 5-5297

Brick Chipping Machine



**INCREASE *Your* INCOME WITH
THE ROCKFACER**

U.S. PATENT NO. 2,801,626 — FOREIGN PATENTS PENDING

ROCKFACER turns a loss into a profit! 2000 culls per hour transformed into Number 1 PREMIUM rock-faced bricks (as pictured at left).

That's why hundreds of owners — in United States, Canada, and abroad — are loud in their praise of the ROCKFACER. Some own as many as 6 machines. One owner reports, "Ours paid for itself 3 times in the first 9 months!"

SEND SAMPLES OF YOUR BRICK. Put through the ROCKFACER, they come out with a straight-chipped edge for laying a neat course quickly. YOU judge your own profit potential. Prices and specifications on request.

**ROCKFACER CO., 503 Hickory Tree Rd.,
Mesquite, Texas
(P.O. Box 547 — Phone ATLantic 5-5297)**

Physical Specifications:

Weight: 1750 lbs.

Dimensions: Length 11' 2"

Width 2' 10"

Height 4' 6"

Power: 1½ HP Fairbanks Morse Electric Motor

Speed Reducer 1.48 HP input,

932 in. lbs. torque

Cutler Hammer Starter

Casters: 400 lb. load capacity

Transmission Equipment: Standard Parts available at local suppliers—sprockets, pulleys, chains, belts

Operational Data:

Handles 8" Roman, Norman, and SCR brick.

(Some other sizes rockface satisfactorily, depending on size, cross-section, and composition of brick.)

Special attachments included to rockface ends on 8" size.

Handles 2000 8"-size brick per hour.

(Longer brick reduce quantity accordingly.)

Chips face with a straight edge for laying a neat mortar joint.

Texture is a pleasingly convex rounded effect.

Creates beautiful shadowing when laid in wall.

Off-grade brick reclaimed and transformed into rockfaced texture by running through Rockfacer.

Partial List of Users:

ACME BRICK CO. (8 machines)
Fort Worth, Texas

HENDERSON CLAY
PRODUCTS CO. (2 machines)
Henderson, Texas

MARTINSVILLE BRICK CO.
Martinsville, Indiana

NATCO CORPORATION
Nelsonville, Ohio

POSTON BRICK & CONCRETE
PRODUCTS CO.
Springfield, Illinois

RELIANCE CLAY PRODUCTS
CO. (2 machines)
Dallas, Texas

SASKATCHEWAN MINERALS
(Clay Products Division)
Estevan, Saskatchewan, Canada

JAMES SELKIRK PTY. LTD.,
Ballarat, Victoria, Australia

TAYLOR CLAY PRODUCTS
INC.
Salisbury, North Carolina

TEAGUE BRICK & TILE CO.
Teague, Texas

ROSICLARE LEAD AND FLUORSPAR MINING COMPANY

ROSICLARE, ILLINOIS

DOMESTIC FLUORSPAR

ACID & CERAMIC GRADE—ROSICLARE BRAND
FOR GLASS, PORCELAIN ENAMEL & STRUCTURAL CLAY PRODUCTS

Product:

WHITE fluorspar, especially prepared for porcelain-enameling and glass-making.

Producer:

The Rosiclare Lead and Fluorspar Mining Company, has operated for better than sixty years on its own mine holdings and produced from its own crude ore tailored grades of fluorspar under the trade name "ROSICLARE FLUORSPAR."

Production:

WHITE, thoroughly milled ore, selected to meet chemical guarantee is ground to screen specifications.

Guaranteed Analysis:

Rosiclare Brand Fluorspar is guaranteed to analyze 95 percent calcium fluoride and not to exceed 2.50 percent silica. Ferric oxide 0.04 percent.

A typical analysis follows:

Approximate Analysis (Dry Basis):

Calcium Fluoride	96.02 %
Silica	1.43 %
Ferric Oxide	.04 %

Screen Analysis—Tyler Rotap Machine:

Mesh	Coarse Ground %	Fine Ground %
	Passing	Passing
20	100.00	100.00
28	96.91	100.00
35	85.53	100.00
48	73.55	98.90
65	62.87	87.70
100	52.19	71.30
150	40.21	58.30
200	30.73	42.50
325	21.95	30.90

Shipments:

BULK: In paper lined box cars and covered hopper cars.

PACKED: 100 pound paper bags.

Acid Grade Fluorspar:

For the trade that demands a higher Calcium Fluoride the Rosiclare Lead and Fluorspar Mining Company also produces a powdered acid grade fluorspar guaranteed as follows:

Calcium Fluoride	97 % and over
Silica	1 % and under

Clay Products Usage:

Fluorspar is the only mineral known which will prevent the green scumming of buff clay products. The action of fluorspar in preventing vanadium scum, or efflorescence, differs materially from the action of barium carbonate — commonly used to prevent white or sulphate scum on red burning brick. However, the fluorspar addition to the clay is made at the pug mill in a manner similar to the barium addition. Where the barium makes the sulphate insoluble, fluorspar makes the vanadium volatile, enabling it to be driven out of the clay body during the firing cycle.

Rosiclare Lead and Fluorspar Mining Company also produces fluorspar in the various metallurgical grades (fluxing spar) used in steel and related industries.



ST. JOSEPH LEAD COMPANY

250 PARK AVENUE, NEW YORK 17, N. Y. YUkon 6-7474

Plant and Laboratories: Monaca 7, Penna.

GRADE	Red Label 30	Green Label 42	Green Label 43	Green Label 10	Green Label 17	Green Label 44
Representative Chemical Tests						
ZnO	99.4%	99.4%	99.4%	99.4%	99.0%	99.2%
Pb	.02	.02	.02	.02	.02	.02
Cd	.01	.01	.01	.01	.01	.01
Fe	.015	.015	.015	.015	.015	.015
Total S as SO ₃	.05	.05	.05	.05	.35	.10
H ₂ O Soluble Salts.....	.15	.15	.15	.15	.70	.20
Insoluble in HCl.....	.15	.15	.15	.15	.15	.15
Loss at 110°C.....	.30	.30	.30	.30	.30	.30
Representative Physical Tests						
Particle Size—Light Microscope						
Average Numerical Diameter D ₁ —Microns.....	.23	.28	.30	.37	.44	.60
Average Surface Diameter D ₃ —Microns.....	.58	.65	.77	.79	.87	1.10
Specific Surface—Sq. M./gram.....	1.92	1.69	1.42	1.39	1.26	1.00
*N ₂ Specific Surface—Sq. M./gram.....	7.04	5.27	5.02	3.82	3.13	1.50
Apparent Density—Lbs./Cu. Ft.....	28	30	32	35	40	.....
Thru 325-Mesh Screen (44 Micron).....	99.97	99.97	99.97	99.92	99.92	.....

*Nitrogen adsorption using the B.E.T. apparatus.

Granular Zinc Oxide

GREEN LABEL No. 43 and GREEN LABEL No. 44 are available in the form of FREE-FLOWING DUST-LESS GRANULES, having very high apparent density. Granules may be shipped in bulk in hopper cars if desired, and are readily adaptable to bulk handling in the plant. Apparent density of the granules range from 75 to 90 lbs./cu. ft., with granule size ranging up to 10 mesh maximum. The six ceramic grade zinc oxides produced by ST. JOE are suitable for most requirements. Specifications for individual needs can also be developed.

REMARKS

RED LABEL No. 30

Uncalcined zinc oxide with relatively fine particle size.

GREEN LABEL No. 43

Uncalcined zinc oxide with relatively large particle size. Available also in granular form.

GREEN LABEL No. 17

Calcined zinc oxide with large particle size. For use in glazes and enamels where low shrinkage is important.

GREEN LABEL No. 42

Uncalcined zinc oxide with intermediate particle size.

GREEN LABEL No. 10

Calcined zinc oxide with relatively large particle size.

GREEN LABEL No. 44

Heavily calcined zinc oxide with very large particle size and very low surface area, for use in glazes and enamels to obtain minimum shrinkage. Available in granular form.

SALES REPRESENTATIVES

Warehouse stocks maintained in strategically located cities.

AKRON, O., Harwick Standard Chemical Co., 60 S. Selberling St.
Albertville, Ala., Harwick Standard Chemical Co.
Baltimore, Md., William McGill, 237 President St.
Boston, Mass., Harwick Standard Chemical Co., of Mass., Inc., 661 Boylston St.
Buffalo, N. Y., James O. Meyers' Sons, 290 Larkin St.
Chicago, Ill., Fred A. Jensen & Associates, 510 N. Dearborn St.
Cincinnati, O., C. L. Zimmerman Co., N. 303 Cincinnati Union Terminal
Dallas, Tex., Thompson-Hayward Chemical Co., P. O. Box 6226
Denver Area, Application Engineers, Inc., 100 Jefferson St., Englewood, Colorado
Detroit, Mich., Matteson-Van Wey, Inc., 403 Baltimore Ave., W.
Greenville, S. C., Harwick Standard Chemical Co., 120 N. Markley St.
Houston, Tex., Thompson-Hayward Chemical Co., P. O. Box 4557
Indianapolis, Ind., Meyer Materials, Inc., 5505 No. Keystone
Jacksonville, Fla., C. Withington Co., Inc., 1641 Landon Ave.
Kansas City, Mo., Thompson-Hayward Chemical Co., 2915 Southwest Blvd.
Long Island City, N. Y., C. Withington Co., Inc., 47-40 Fifth Street

Los Angeles, Cal., Harwick Standard Chemical Co., of California, 1248 Wholesale St.
Memphis, Tenn., Thompson-Hayward Chemical Co., 493 N. Front St.
North Little Rock, Ark., Thompson-Hayward Chemical Co., P. O. Box 413
Oklahoma City 19, Okla., Thompson-Hayward Chemical Co., 3909 Meridian Ave.
Omaha, Neb., Thompson-Hayward Chemical Co., 1110 S. Fourth St.
Philadelphia Area, Van Horn, Metz & Co., Inc., 241 E. Elm Street, Conshohocken, Pa.
Pittsburgh Area, St. Joseph Lead Co., Monaca, Pa.
Portland, Ore., Cordano Chemical Co., 56 S.E. Belmont St.
St. Louis, Mo., J. E. Niehaus & Co., Inc., 3419-21 Gratiot St.
St. Paul, Minn., George C. Brandt, Inc., 739 Pillsbury Ave.
San Antonio, Tex., Thompson-Hayward Chemical Co., 222 Seguin St.
San Francisco, Cal., L. H. Butcher Co., 15th & Vermont St.
Seattle, Wash., Great Western Chemical Co., 1242 Sixth Avenue, So.
Trenton, N. J., R. E. Carroll, Inc., P. O. Box 139
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Wichita, Kan., Thompson-Hayward Chemical Co., 727 E. Osle

FRANK SAMUEL & COMPANY INC.

Executive Offices: - - - Philadelphia National Bank Bldg., Philadelphia 7, Pa.

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Fluorspar98 % min. CaF_2
Chrome44 % " Cr_2O_3
Ilmenite58 % " TiO_2
Petalite4.4% " LiO_2

Manganese Dioxide...80 % min. MnO_2
Kyanite58 % min. Al_2O_3
Magnetite60 % " Fe
Lepidolite3.8% " LiO_2

• CUSTOM GRINDING

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AIRFLOATED IRON CHROMITE44% Cr_2O_3

GROUND MANGANESE (all sizes).....42% Mn

MILLED RUTILE97% TiO_2

ZIRCONIUM SILICATE - 66% ZrO_2 min.

Various grades to meet the particular application
Granular, 200, 325, 400 mesh
Low Fe, High ZrO_2

Other metals & minerals on request

Write for information today

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310 Sacramento St.

Makers of the Automatic Weigher Feeder Conveyor

The Schaffer Poidometer is an accurate, durable machine for weighing, feeding and conveying raw materials used in the process industries. Automatic and always dependable, it handles all crushed, granular and pulverized matter.

Proportioning by weight is a function to which the Poidometer is particularly well adapted. In a wide range of applications batteries of Poidometers regulate and facilitate blending and mixing processes, at the same time keeping an accurate, centralized record of the amounts of materials handled.

Poidometers can be furnished with various remote control devices in order to:

- (1) Change speed of belt thus varying rate of feed.
- (2) Register actual speed of belt or rate of feed.
- (3) Record weight of material delivered.

CONSTRUCTION FEATURES

Although designed to meet many varying requirements, all Poidometers incorporate the same proven principles in their construction. Self-contained and mounted on a steel frame, Schaffer Poidometers are equipped with dust-proof ball bearings throughout. All points of stress are case hardened. The steel hopper is so arranged that the belt passing beneath pulls the materials from it.

Equipped with double knuckle joints, the regulating gate moves on rollers enclosed in a special housing and is polished inside to eliminate any friction.

Standard equipment on all Poidometers includes: the drive consisting of motor, worm gear unit, and chain and sprockets; the recording device showing the amount of material delivered in any specified time; and the automatic control gate, which stops the Poidometer when the material supply in the Poidometer hopper becomes too low.

This last feature is very important when two or more Poidometers are proportioning materials, since all Poidometers in the battery cease operating together. When material is again supplied to the hopper, all Poidometers automatically resume operation. This assures an accurate mixture by weight, since the Poidometer belts are fully loaded at all times.

A recording device can be furnished to register a direct reading in pounds, tons or barrels; also to furnish a reading at a distance from the Poidometer.

SPECIAL TYPES AND ATTACHMENTS

By means of special attachments Poidometers can be adapted to meet the specific requirements encountered in a large number of industrial applications. Mounted on trucks, Poidometers become portable, enabling one Poidometer to serve a series of bins or other units. Equipped with a liquid measure, the Poidometer can accurately proportion solids and any free-flowing liquid. The special non-flood hopper permits the extremely accurate weighing and proportioning of finely ground materials such as Fullers Earth, Hydrated Lime and Cement. Improved construction of the non-flood hopper has increased the efficiency of this unit so that it is now weighing and proportioning many difficult materials with great accuracy.

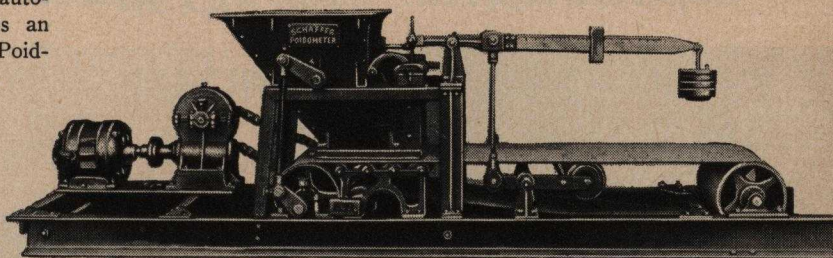
CAPACITIES OF THE POIDOMETER

SIZE		MAXIMUM CAPACITY*		Maximum Size of Cubes	Available With Motor Operated Gate
Belt Width	Length Scale Platform	Light Duty	Heavy Duty		
6"	2' 0"	2 Tons		Finely ground	No
10"	2' 6"	5 Tons		Finely ground	No
	4' 6" & 6' 0"		10 Tons	Finely ground	No
14"	2' 6"	8 Tons		1/2" Cubes	No
	4' 6" & 6' 0"		20 Tons	1/2" Cubes	No
20"	2' 6"	15 Tons		1 1/2" Cubes	No
	4' 6" & 6' 0"		45 Tons	1 1/2" Cubes	Yes
30"	4' 6" & 6' 0"		125 Tons	3" Cubes	Yes
36"	4' 6" & 6' 0"		160 Tons	4" Cubes	Yes
48"	4' 6" & 6' 0"		250 Tons	4 1/2" Cubes	Yes

*Figured on material weighing 100 lbs. per cubic foot. Amount shown is capacity per hour.

Additional conveyor installations can often be avoided by the installation of an Extra Long Poidometer. Any length up to 35'0" can be obtained, all possessing the same high degree of accuracy.

All Poidometers can be equipped with a variable speed drive or a magnetic discharge pulley such as is used for the extraction of tramp iron from clay.



MATERIALS HANDLED BY POIDOMETERS

Alum	Coal Culm	Dolomite	Iron Ore	Oxydol	Sandstone
Bauxite	Coke—breeze	Feldspar	Iron Scale	Phosphate Rock	Seashells
Bran	Coke—Pulverized	Ferric Sulphate	Lead Ore	Potash Salts	Sinter
Calcium Carbonate	Copper Ore	Flue Dust	Lime Pebble	Potato Flour	Slag—open hearth
Carbon—activated	Copper Concentrates	Fullers Earth	Lime Hydrated	Pulp	Soda Ash
Cement	Copperas	Gluten	Lime Granular	Quartz	Soya Bean Meal
Charcoal	Corn Oil Meal	Graphite	Lime Quick	Red Dog	Stone
Clay	Cottonseed Meal	Gravel	Limestone	Rice	Sugar
Clinker	Cracklings Ground	Gypsum	Manganese	Salt	Sulphur
Coal	Cracklings Finished	Hominy	Middlings	Sand	Zinc Oxide

WRITE FOR CATALOG NO. 10

ARTHUR W. SCHMID COMPANY

ENGINEERS and CONTRACTORS

INVESTMENT BUILDING

PITTSBURGH 22, PA.

Cable Address "SCHMID" Pittsburgh

COMPLETE NEW GLASS PLANTS AND EQUIPMENT OR MODERNIZATION OF EXISTING FACTORIES

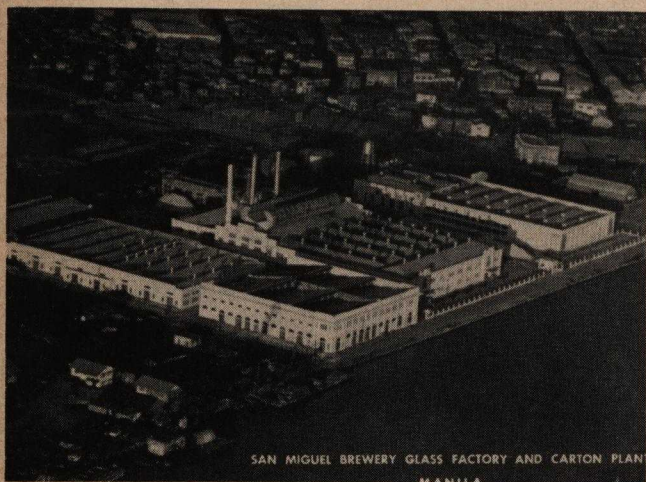
FOR MANUFACTURE OF PRESSED AND BLOWN WARE — TUBING
ROLLED OR DRAWN FLAT GLASS

Batch Systems — Fuel Systems — Batch Feeders — Gas and Oil Fired Glass Melting Furnaces — Electric Glass Melting Furnaces — "Liberty" Gob Feeders — Hand and Automatic Forming and Finishing Machines — Automatic Handling Equipment — Automatic Control Equipment — Stackers — Annealing and Decorating Lehrs — Bending and Tempering Equipment — Continuous Grinding and Polishing Plants for Plate Glass

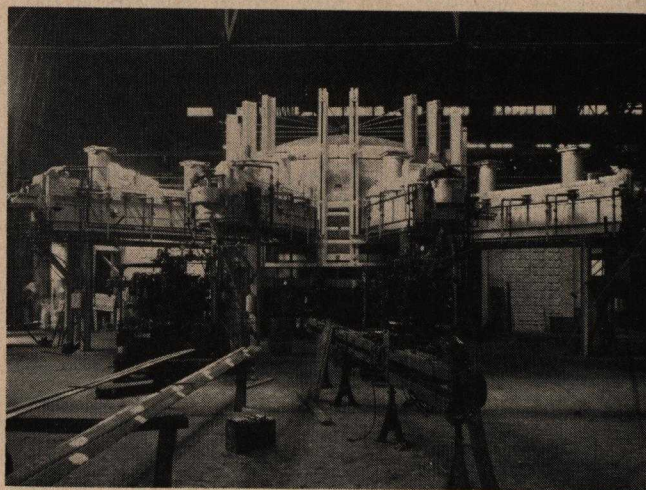
DESIGN

ERECTION

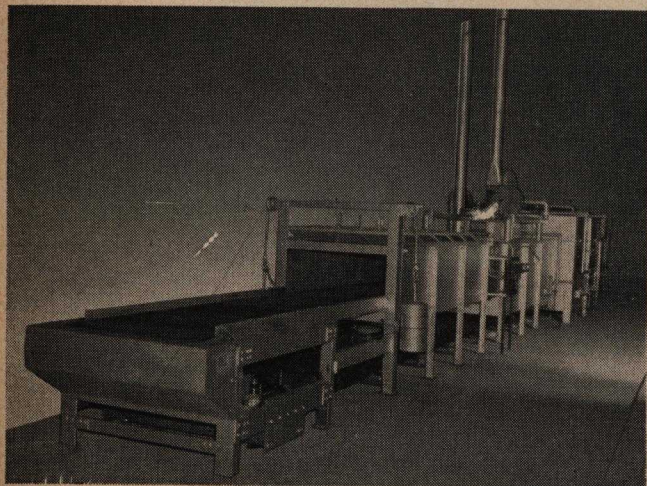
OPERATION



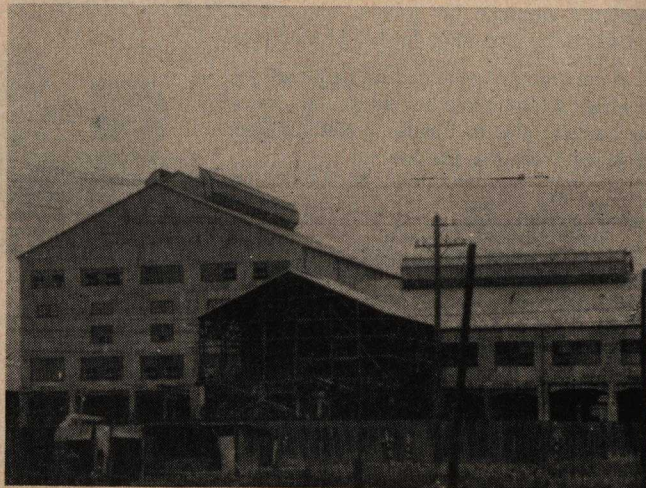
Complete Glass Bottle Plant



80 Ton Furnace With 4 "Liberty" Gob Feeders



Decorating Lehr



Fourcault Window Glass Plant

SHENANDOAH SILICA CO., INC.

MINES AND MILLS: GORE, VA.

EXECUTIVE OFFICES: TRENTON, N. J.

**Western Representative:
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SHENANDOAH FLINT

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•UNDER ALL CONDITIONS

SHENANDOAH FLINT is widely known throughout the industry for Highest Quality and Uniformity . . . Mined at our own properties and milled in our own plant, with thoroughly modern equipment in every step of production . . . Recent increase in capacity assures prompt shipments at all times.

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FOR

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POTTERS' FLINT

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SHENANGO REFRACTORIES

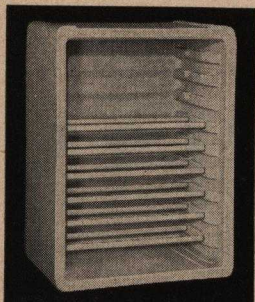
DIVISION OF SHENANGO CHINA, INC.

Post Office Box 120, New Castle, Pa.—Oliver 2-6661



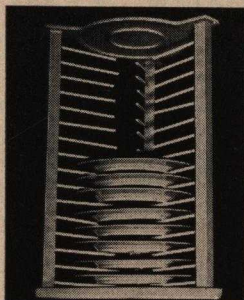
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needs and problems . . . just call us.



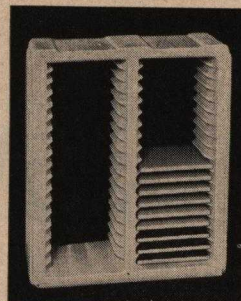
GLOST TILE PIN SETTER

Clean cast tile setters designed to increase kiln capacity, reduce losses caused by kiln dirt.

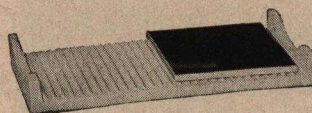


GLOST FIRING RACK

Complete line of glost firing racks provide lowest refractory weight-per-unit of ware fired . . . greater payload per car.



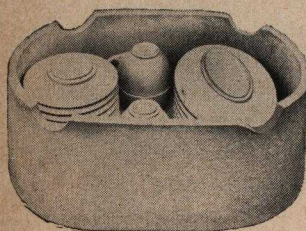
GLOST COMPACT TWO-CELL TILE SETTER



ONE-FIRE TILE SETTERS offer exceptional quality and durability . . . available in a variety of sizes and designs.

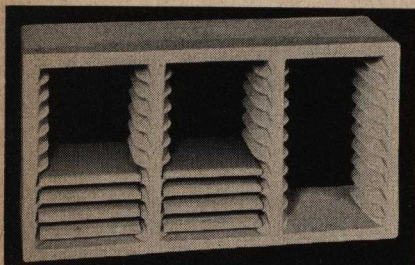
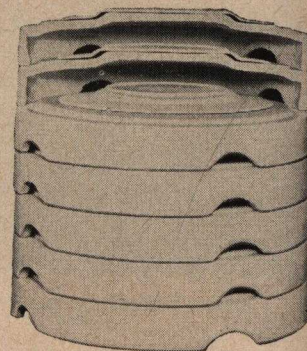
SHENANGO BISQUE SAGGERS

Shenango bisque saggers are stronger and more uniform—proven to be most economical on a cost per trip basis. Sagger bottoms remain straight throughout their long life.



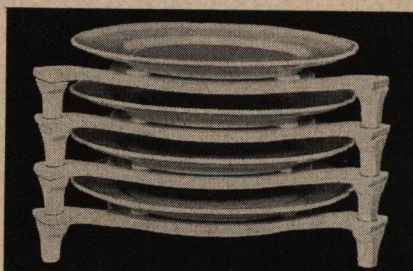
SHENANGO BISQUE CRANKS

Designed to give the proper support to fine china during the bisque firing. Cranks made to your requirements make fine china of uniform contour and interval possible on a production basis.

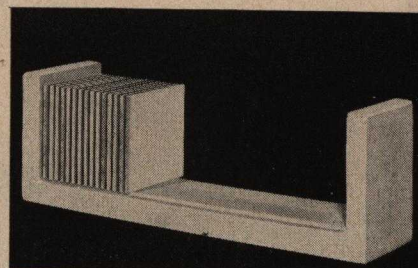


SHENANGO GLOST TILE SETTER

These setters are cast of a clean, strong composition which gives lowest tile losses and long setter life. The above is one of several shapes.



SHENANGO SPIDERS. Used for one-fire ware, glost, and decorating firing. Spiders are clean, durable, light, strong, and readily adaptable to mechanical handling . . . saves labor.



SHENANGO BISQUE TILE SNOW-SHOE SETTER. These setters are cast of a uniformly strong, clean composition—made to your specifications to provide maximum kiln fill.

54 YEARS OF ENGINEERED REFRACTORIES

SOCONY MOBIL OIL CO., INC.

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and Affiliates:

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MOBIL OVERSEAS OIL CO., INC., New York, N. Y.



Wax Emulsions

MOBILCER C MOBILCER R

Binders for non-plastics, refractories, abrasives. Give high green strength without moisture, uniformly reduce shrinkage.

MOBILCER X

Binder for floor tile, refractories. Gives maximum green strength with moisture.

PHYSICAL CHARACTERISTICS

All Mobil Wax Emulsions have solids contents of about 46%. They are free flowing homogeneous dispersions of different types of petroleum wax in water, and are added as such, or diluted where desirable with water, directly to the ceramic mixes.

Mobilcer C contains a paraffin wax of 125°F ASTM melting point;

Mobilcer R contains a microcrystalline wax of 170°F ASTM melting point;

Mobilcer X contains both a microcrystalline wax of 170° F ASTM melting point, and a special water soluble binder to promote maximum binding strength in the presence of moisture.

HOW TO USE THESE PRODUCTS

Mobilcer C is usually effective at 4% to 6% for completely dry pressing of steatites, titanates, oxides, and other non-plastics. It is non-migrating and provides excellent pressing characteristics for high speed automatic pressing.

Mobilcer R, with its microcrystalline wax, provides maximum binding properties for non-plastics where the slightly higher cost is justified. It is a standard binder for pressing abrasives with re-

duced moisture content.

Mobilcer X, as low as ½% by weight, provides maximum green strength for pressed bodies which contain appreciable moisture, such as floor tile and refractories.

IS YOUR COMPETITION PASSING YOU

—Maybe they are using Mobil Wax Emulsions. Socony Mobil technical men are ready to help you.

Mobil Process Products

SOUTHERN CLAYS, INC.

For Over 50 Years

Producers of Water Washed Kaolin

Mines and Plant—Gordon, Ga.

Office—33 Rector St., New York 6

Sales Representative—GEORGE R. SWINNERTON

Alliance, Ohio

NO. 27

WATER WASHED KAOLIN

Water Washed for:

No specks—no mica
Controlled uniformity

For Casting Sanitary Ware, etc.

By exact fractionation and blending these fractions in slip form in agitators, a controlled particle size distribution is effected. As a result #27 is ideal for casting with the following resultant properties:

Fast even cast
Maximum fluidity
Rapid response to deflocculants
Fast setting up
Low Shrinkage

For Plastic Processes—Electrical Porcelain Dinnerware:

Faster filter pressing of body
Faster and straighter drying
Less warping in firing

For Dry Mixing—Shipped in bags Micro Pulverized.

Control—Every carload undergoes numerous laboratory control tests.

PHYSICAL CHARACTERISTICS

Dry Shrinkage	4.00%
Total Shrinkage Cone 10.....	12.50%
Absorption Cone 10.....	22.00%
Casting Rate	280 gm
Viscosity	22 Seconds
Modulus of Rupture:	
Clay Alone	25 lbs.
Residue 200 Mesh.....	.016%
Settling	2 inches

NO. 600

WATER WASHED KAOLIN

Water Washed for:

Uniform strength
No dirt—specks—mica

High Dry Strength

An extremely strong, plastic kaolin
Stronger than most ball clays

Fired Color—White Burning—Excellent Translucency

Used in vitrified china bodies especially vitrified dinnerware, imparting better translucency than other china clays or kaolins.

Used Successfully in:

Vitrified China
Sanitary Ware
Electrical Porcelain
Special Glazes (Glazed brick & tile)
Vitrified Floor Tile

Control—Every carload undergoes numerous laboratory control tests.

PHYSICAL CHARACTERISTICS

Dry Shrinkage	7.80%
Total Shrinkage Cone 10.....	19.00%
Absorption	14.00%
Casting Rate	135 gm
Viscosity	41 Seconds
Modulus of Rupture:	
Clay Alone	651 lbs.
50% Flint	450 lbs.
Residue 200 Mesh.....	.01%
Settling	¼ inch

NOTE:

CASTING SPEED is the weight of a cup, cast 15 min. on China Clays, ½ hour on Ball Clays—Drained and Dried.

SETTLING—A 250 ML Graduate is filled with Slip & Spec. Gr. 1.25—Settled for 24 hours—Clear water measured in inches—No Deflocculant.

THE SPENCER TURBINE COMPANY

507 New Park Avenue, Hartford 6, Connecticut

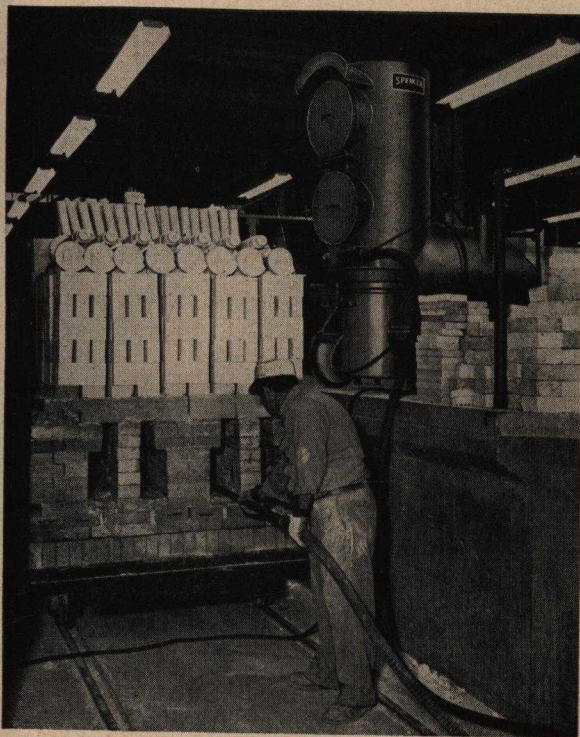
REPRESENTATIVES IN 50 CITIES

Stationary Vacuum Cleaning Systems

PRODUCTS:

Portable Vacuum Cleaners

Turbo-Compressors



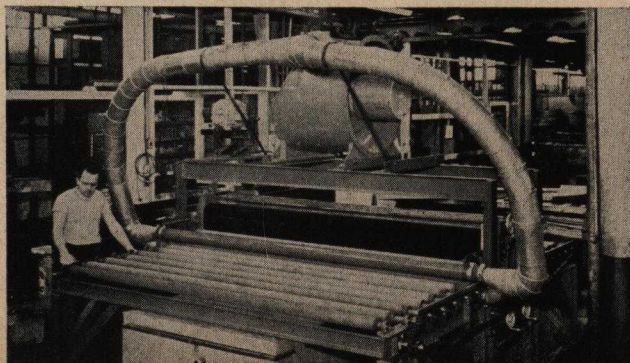
Kiln Cleaning

SPENCER VACUUM CLEANERS

Spencer Vacuum equipment is used for two main purposes in industry. First to provide fast working low cost cleaning for the safety and sanitation of the plant. Secondly, as a production aid to prevent rejects due to dust, to convey bulk raw materials and to reclaim valuable waste.

Portable machines are available from $\frac{1}{2}$ to 15 HP and Stationary types up to 100 HP. More than 100 vacuum tools have been perfected for the special needs of all types of industries. Many sizes and types of vacuum hose are available for the tough jobs of industry, including the handling of hot materials.

POTTERY PLANTS: Many of the rejects in pottery plants are the result of specks of dirt or coloring distributed through the air or falling from ceiling, pipes and walls. With Spencer Vacuum, the plant can be kept clean at all times, and rejects reduced to a minimum.



Drying Mirror glass

ENAMEL STENCILS: A special Spencer vacuum tool is used to remove excess material around stencils in enameling plants. It is easy to handle; a tap on the table or bench opens the vacuum valve and a slight flip of the wrist closes it. It keeps the benches clean at all times, without raising injurious dust.

KILN CLEANING: The removal of sand and brick spalls from the flues of a brick kiln is a necessary but an uncomfortable, dirty, time consuming and expensive job. With high powered, heavy duty Spencer Vacuum equipment this work, which formerly took eight to ten hours, can now be accomplished in two hours. Also, the cleaning can start while the flues are still hot. A tool, screened to keep out the larger piece of brick, and curved to fit the flues, then reaches into the out-of-the-way places where the sand accumulates. An automatic discharge valve on the bottom of the separator permits continuous flow of material without shutting down to empty the hopper.

Spencer Portables and Stationary Systems are described in Bulletin No. 155B.

SPENCER TURBO COMPRESSORS

Spencer Turbo-Compressors are designed especially for furnishing large volumes of air at constant pressure under absolute control and with high efficiency at all loads.

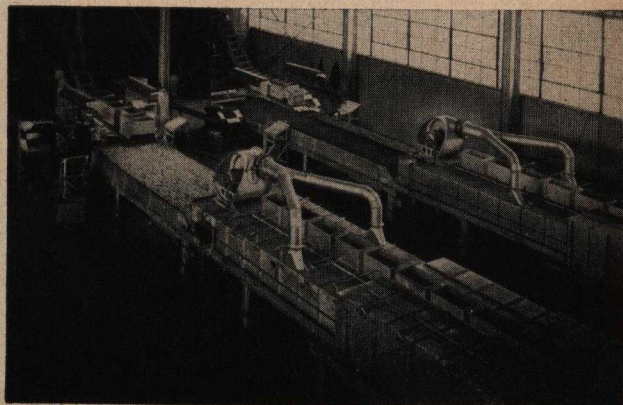
USES—Used mainly for furnishing air supply for gas and oil fired furnaces and ovens, cupolas, heat treating and japan enamel, ceramic and core ovens.

Illustrations below show the application of Spencer Turbos for burners and recirculation in a lehr and a special application for blowing moisture from mirror glass as it comes off the production line.

Spencer Turbo-Compressors produce a practically constant pressure from no load to full load. If the volume of air in use is reduced the pressure will not run up. If full volume is suddenly required the pressure will not fall.

Gas-tight and special turbos are supplied for use where acid fumes or poisonous or explosive gases are handled.

Sizes 35 to 20,000 cu. ft., $\frac{1}{3}$ to 1000 H.P., 4 oz. to 10 lbs. Ask your equipment manager or write us for the Spencer Turbo Bulletin No. 126B.



Cooling Glass lehrs

STAUFFER CHEMICAL COMPANY

380 Madison Avenue
New York 17, N. Y.



636 California Street
San Francisco 8, Calif.

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Akron 8: 326 South Main StreetTelephone Portage 2-7423

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Houston 15: P. O. Box 9716Telephone Glendale 3-7176

Stauffer Borax and Boric Acid of both Technical and U.S.P. grades are specially prepared for the Ceramic industry. More than 70 years of experience in the production of high-grade chemicals assures delivery of Stauffer Boron Products at specifications demanded for the production of finest enamels, frits, glass and glazes.

BORAX

BORAX PENTAHYDRATE (5-Mol)

ANHYDROUS BORAX

BORAX GLASS

BORIC ACID

Packaging

100-pound net bags or bulk in cars, except Boric Acid in bags only.

Stocks

Borax, Anhydrous Borax, Borax Glass and Borax Pentahydrate (West End Brands) from West End, Calif., and principal cities throughout the country; Boric Acid from San Francisco and principal cities. Catalog on request.

Other

Stauffer Chemicals
for the Ceramic Industry

Boron Oxide and Boron Trichloride, Potassium Nitrate, Caustic Soda, Tartar Products, Sulfuric Acid, Sulfur in all grades and forms.

SEND FOR STAUFFER'S NEW CATALOG OF BORON PRODUCTS

SIMPSON Mix-Millers®

NATIONAL
ENGINEERING COMPANY
549 W. WASHINGTON BLVD.
CHICAGO 6, ILLINOIS

**do you
prepare**

DINNER AND ARTWARE?

You can reduce preparation time from days to minutes with Mix-Muller. Dry mixing permits use of air floated clays — *eliminates* costly maintenance and labor involved with slip houses, blungers and filter presses. Control of moisture and body plasticity pays off in attractive, sales winning ware.

REFRACTORIES AND REFRACTORY CEMENTS?

It takes the intensive kneading, smearing action of a Mix-Muller to provide proper dispersion of stiff refractory bodies & binders. No mixer on the market can give you similar control over moisture content... so important to dimensional stability and adaptability to dry pressing.

ELECTRICAL PORCELAIN?

Mix-Mullers are helping to contribute to the density of structure, fired strength, high dielectric values, high yield, conformity to pattern and freedom from metallic contamination for insulating and transmission wares ranging from insulators to minute transistor wafers. Wherever high, efficient production is mandatory — whether it be pressed or extruded... you'll find a Mix-Muller!

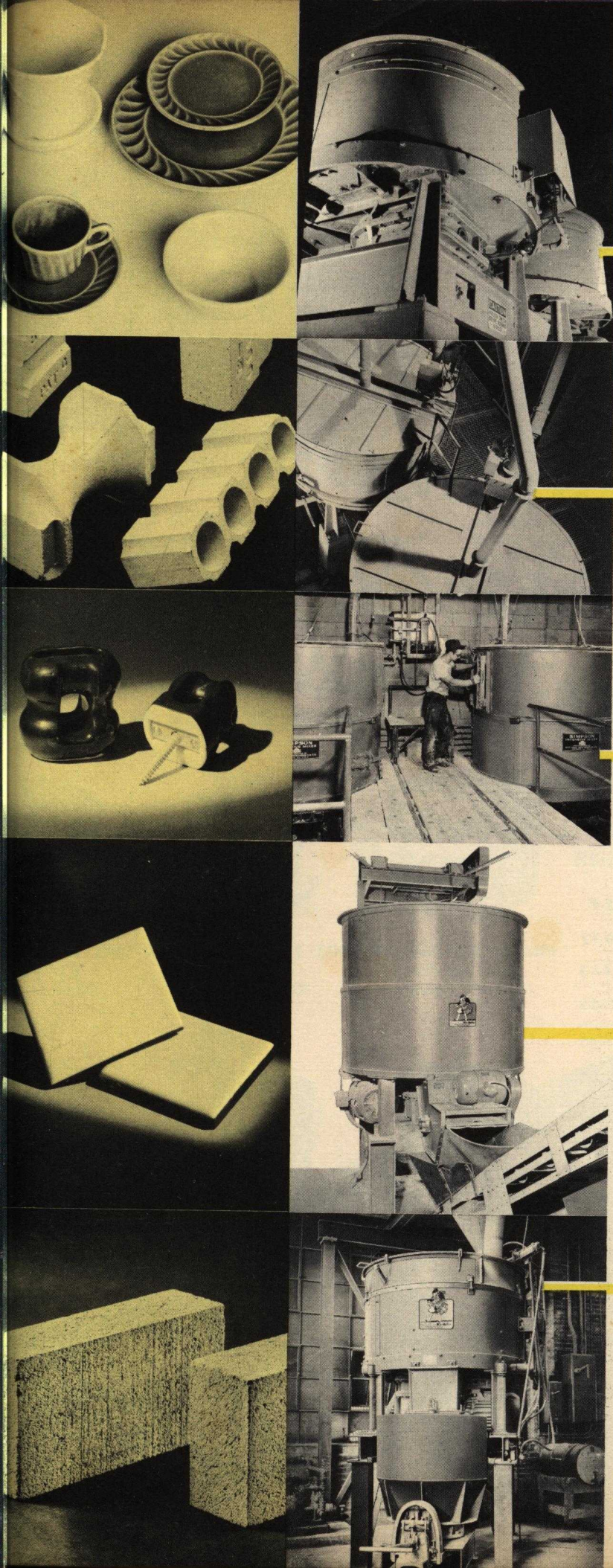
TILE?

Mixing floor and wall tile bodies in a Mix-Muller will provide you with the kind of color fidelity and quality demanded by your accounts. Stain and carrier are subjected to intense, smearing *spatulate* action. The resultant body provides the desired control for the forming and gives exceptionally high yields of finished tile.

STRUCTURAL CLAY PRODUCTS?

Reprocessing of prepared clays can be eliminated with the Mix-Muller. Absolute control over body formulation and moisture pays off in top grade, dimensionally stable brick or structural clay products which will find a ready market. What's more, a Mix-Muller installation will usually occupy far less floor area in the plant than any equipment for similar use.

See Next Page for
Capacity and Specifications



SIMPSON MIX-MULLERS® for the Ceramic Industry



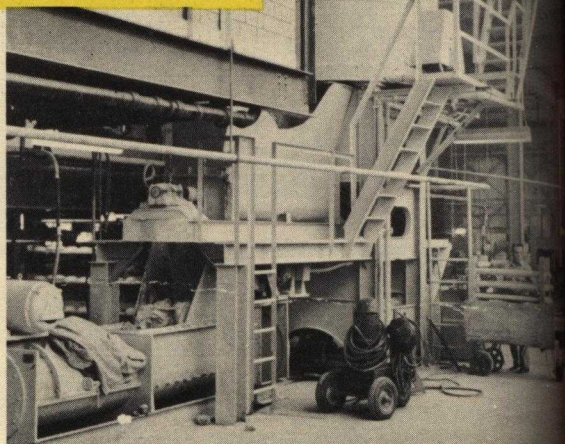
AUXILIARY EQUIPMENT

Loading, storing, handling, batching, metering and timing devices are available for all models of the Simpson Mix-Muller. Each item is engineered as a companion piece for the Mix-Muller and is designed to take the guesswork out of the operation of your mixing facilities.



LABORATORY FACILITIES

Complete facilities are available for controlled laboratory testing of your material in the Simpson Mix-Muller. Results are confidential, frank and available to you without obligation. Write for Confidential Test Form.



ENGINEERING SERVICE

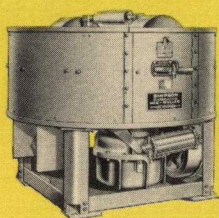
National offers a complete materials handling and engineering service plus a background of experience in problems concerned with mixing that is available from few if any other source. With it, you can be assured of a single, coordinated and responsible source for advice on materials handling and mixing operations.

CONDENSED SPECIFICATIONS

MODEL	PAN DIA.	MOTOR (HP-RPM)	MULLER WEIGHT	CAPACITY (CU. FT.)
LF(LAB)	24"	1-1800	30 To 80 lbs.	1/2-3/4
05 Porto-Muller	39"	3-1800	100 To 250 lbs.	2 1/2-3 1/2
1F	50"	7 1/2-1800	200 To 500 lbs.	5-7
1 1/2 F	64"	15-1800	400 To 1000 lbs.	10-12
*2H	72"	20-1800	700, 1000, 1600 lbs.	12-15
2F	80"	30-1800	800 To 2000 lbs.	20-25
2 1/2 F	90"	60-1800	1200 To 3000 lbs.	35-40
*3H	96"	50-1800	2200 or 3400 lbs.	25-30
3F	100"	75-1800	1600 To 4000 lbs.	50-60

*These Models do not have spring loaded Mullers.

SIMPSON MIX-MULLERS ARE AVAILABLE IN BATCH CAPACITIES OF FROM 1/2 to 60 CU. FT.



NO. 3F MIX-MULLER
8'4" pan dia.
60 cu. ft. capacity



NO. 2 1/2 F MIX-MULLER
7'6" pan dia.
40 cu. ft. capacity



NO. 2F MIX-MULLER
6'8" pan dia.
25 cu. ft. capacity



NO. 1 1/2 F MIX-MULLER
5'4" pan dia.
12 cu. ft. capacity



NO. 1F MIX-MULLER
4'2" pan dia.
7 cu. ft. capacity



PORTO-MULLER
3'3" pan dia.
3 1/2 cu. ft. capacity
(100% Portable)

WRITE FOR Confidential Test Data Form and instructions for preparing sample quantity of your materials for shipment to Chicago for a no-obligation mulling analysis in our laboratory.

LF Laboratory MIX-MULLER

24" pan dia.
3/4 cu. ft. capacity
Widely used for pilot
plant applications.



**SIMPSON
MIX-MULLER
Division**

NATIONAL
Engineering Company
549 West Washington Street
Chicago 6, Illinois

Mixing and the integration of mixing facilities is our business . . . and has been for over 40 years.

DIRECT-FIRED KILNS (GAS, OIL, COAL) • FULL-MUFFLE and SEMI-MUFFLE KILNS
MULTI-BURNER KILNS • RECIRCULATING GAS TUBE INSTALLATIONS
CIRCULAR TUNNEL KILNS (CONTINUOUS PLATFORM & CAR TYPES)
CONVEYOR KILNS (ROLLER HEARTH & WALKING BEAM TYPES)
DRESSLER UNIFAB (PREFABRICATED TUNNEL KILNS)

Quality ***Dressler Kilns and Plant Engineering***

**for the Heavy Clay Products and
Fine Ceramics Industries**



KILNS FOR HEAVY CLAY PRODUCTS	PAGES 2-3
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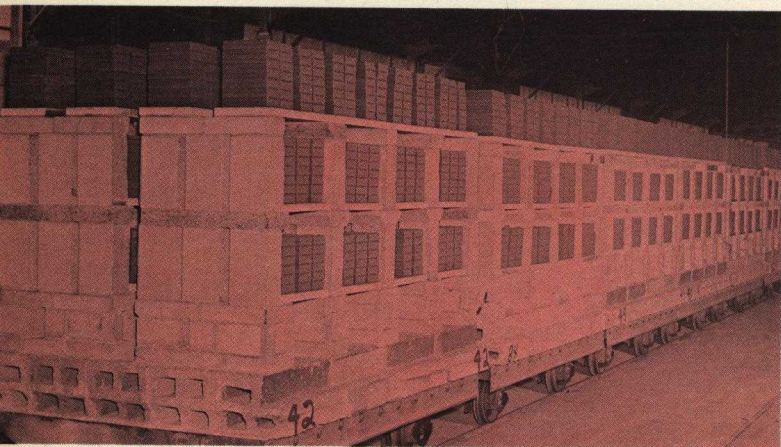
KILNS FOR FINE CERAMICS	PAGES 4-5
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ENGINEERING SERVICES	PAGES 6-7
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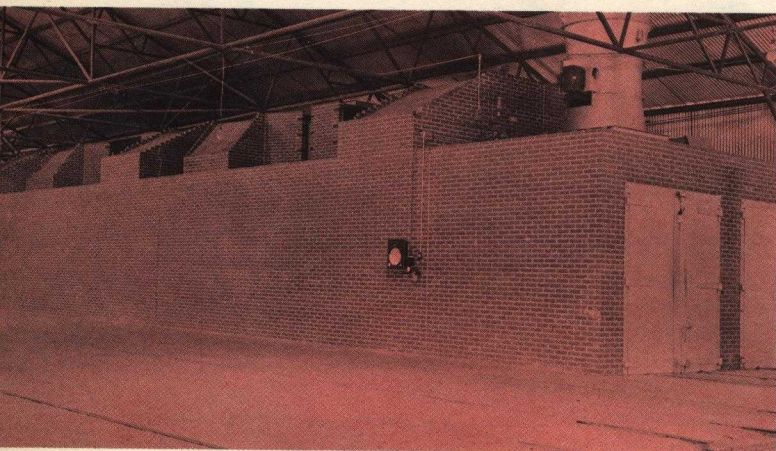
UNIFAB KILNS	PAGE 8
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SWINDELL-DRESSLER CORPORATION • PITTSBURGH 30, PA.

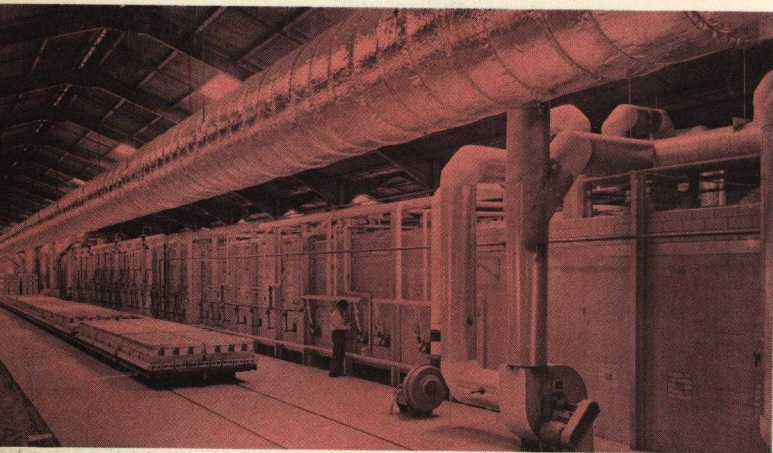
DRESSLER *Quality*



Red and buff quarry tile and acid-resisting floor brick fired in a Recuperative Dressler Multi-Burner, Gas-Fired Kiln.



Twin track preheater dryer for drying brick loads directly set on tunnel kiln cars from off-bearing belt.



70 tons per day of glazed building units, fired in a Dressler Recuperative Multi-Burner Kiln.

Firing at temperatures up to Cone 35, Dressler Kilns provide uniform heat distribution at every stage of the firing, in car settings up to 10' wide. Unique methods have been perfected to secure complete oxidation of pyrites and carbonaceous matter by controlling the rate of heat advance and the atmosphere in the preheating zone.

Special cooling zone features have been developed where unusual difficulties in cooling are imposed by the size, shape, or composition of the ware, comprising a combination of controlled rapid cooling in the initial stages with regenerative cooling through the critical range, thus insuring uniform cooling throughout the load at any required rate.

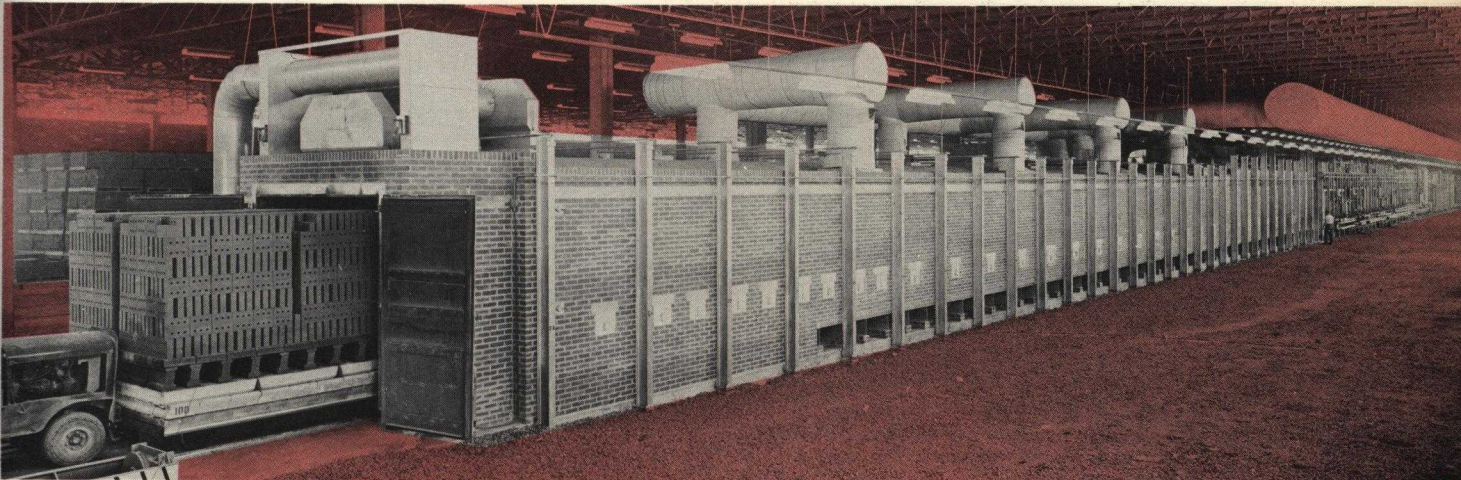
Products handled include building brick, face brick, structural tile, drain tile, sewer pipe, glazed ceramic units, terra cotta, quarry tile, fire brick, silica brick, acid-proof floor brick, magnesite and chrome refractories.

Car bottom Shuttle Kilns of all sizes are furnished for special products and special treatments. They are adapted to small-scale production of glazed brick and building units, for large diameter sewer pipe, special refractories, etc.

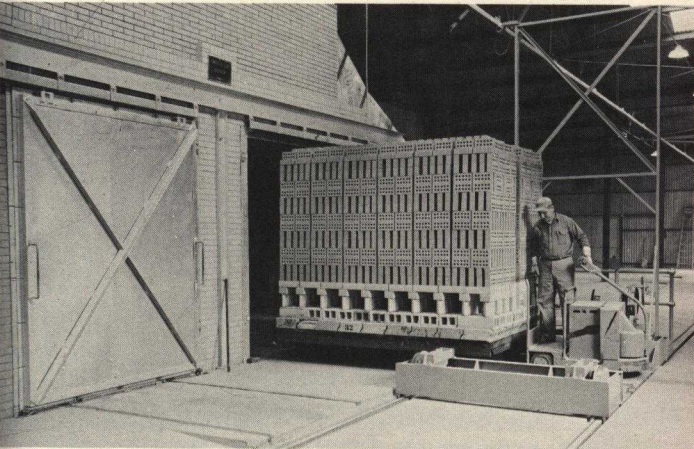
We furnish also complete drying and preheating systems as part of, and coordinated with, our Tunnel Kiln installations.

KILNS

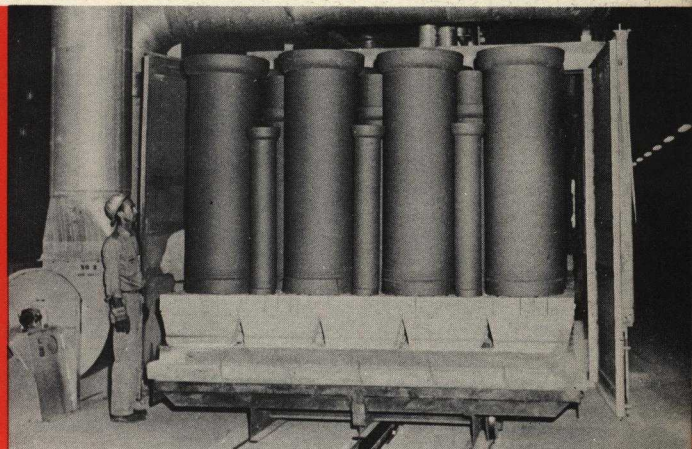
*for heavy clay products
and refractories*



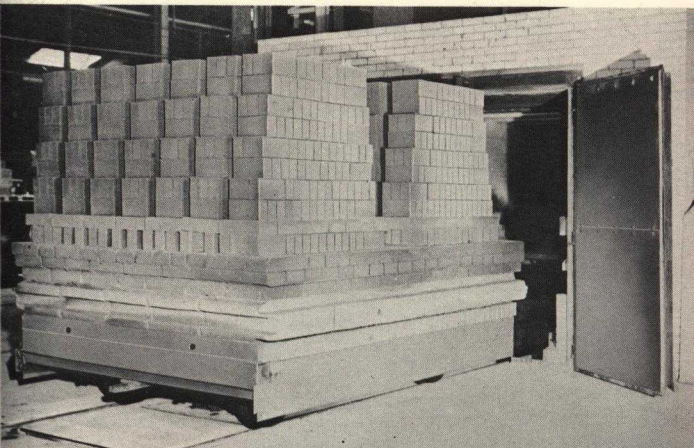
80,000 face brick per day fired through Direct Fired Dressler Kiln burning Bunker "C" oil. 7' 6" wide cars hold 10 stretchers across.



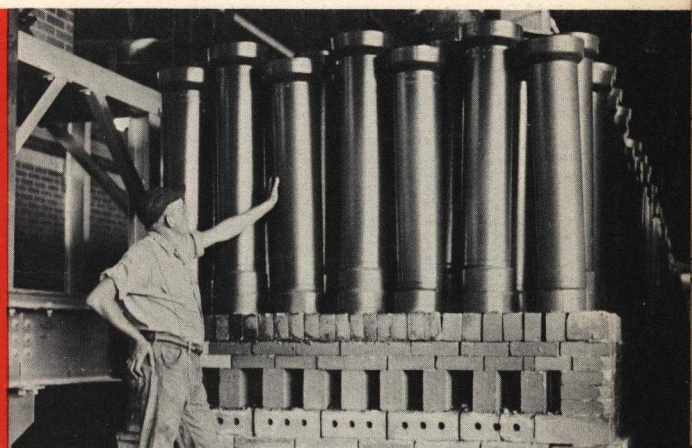
Load of dry, preheated face brick at exit of dryer for transfer to kiln.



18" sewer pipe in 5'0" lengths at exit of kiln. Loads are 10'0" wide.



165 tons of basic refractories per 24 hours, burned to Cone 32.

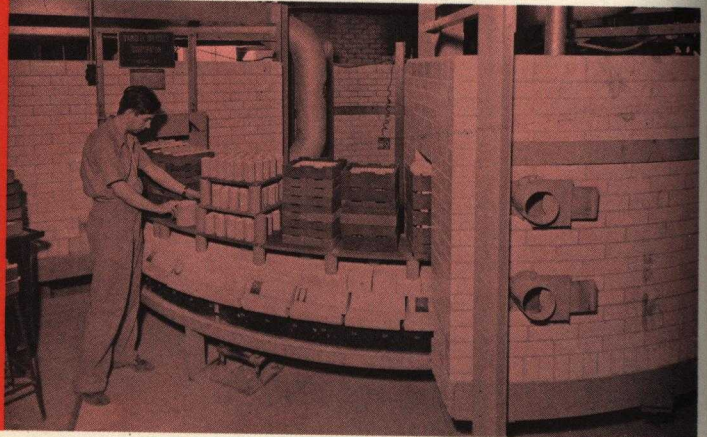


Firing solid loads of 8" salt-glazed sewer pipe on a 46.5 hour cycle.

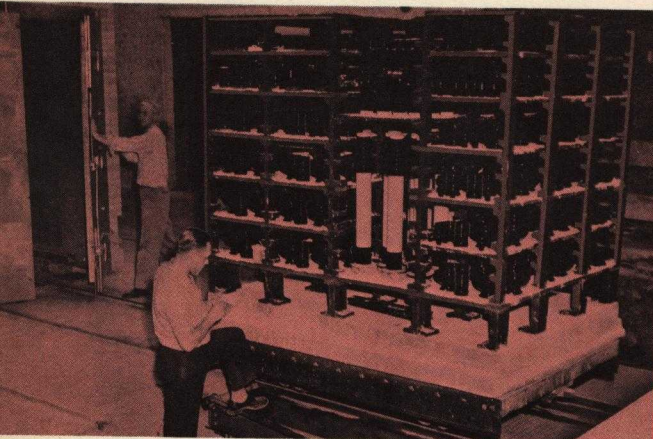
DRESSLER *Quality*



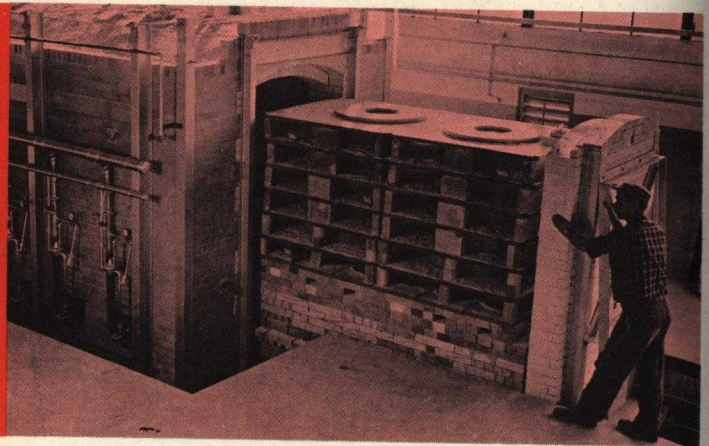
Cars loaded with first fire and refire ware in modern plant equipped with four (4) Dressler Thrift Muffle Kilns.



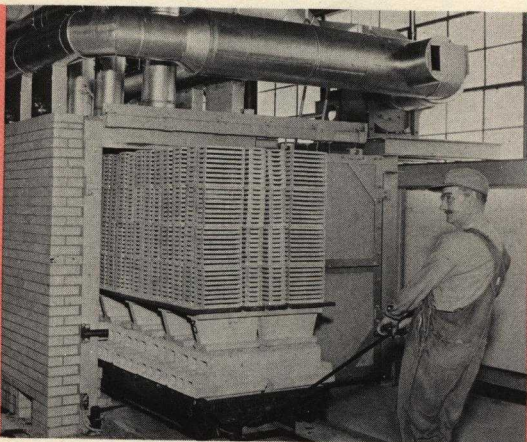
14' diameter Dressler Circular Muffle Tunnel Kiln in Steatite Industry.



Loaded car at exit of recuperative gas-fired Multi-Burner Dressler Tunnel Kiln for high-tension insulators.

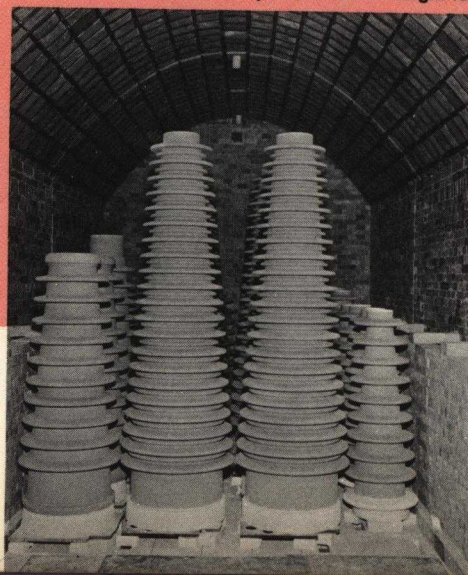


Car bottom Intermittent Kiln for Abrasive Industry. Loads are 4'0" wide x 4'0" high x 8'0" deep.



Dressler Semi-Muffle Kiln for once-fired wall tile. Each car holds 350 square feet.

High-tension electrical porcelain bushings in Dressler Downdraft Intermittent Kiln. Kiln provides 12'6" height to crown.



KILNS

**for fine ceramics
and abrasives**

DRESSLER KILNS are used throughout the ceramic industry for firing all types of white wares, at temperatures ranging from decorating to 3200°F. They are economical in operation because they are recuperative*, and are long-lived because of durable, quality construction.

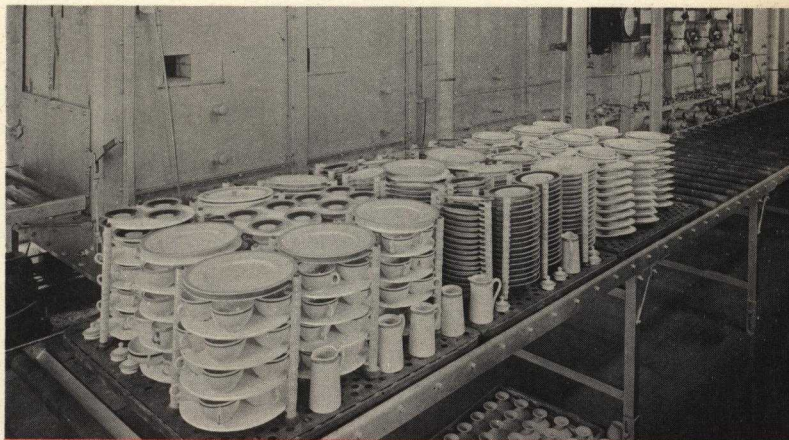
Dressler Kilns pioneered the saggerless firing of glost and bisque ware, and are specially adapted to this economical method of firing.

In addition to Tunnel Kilns, we build Car Bottom Kilns operating under automatic program control for the abrasives industry, for refire sanitary ware, and for other products requiring special cycles and quantities insufficient for tunnel kiln operation.

For large electrical porcelain bushings and other products of unusual size requiring special treatment, Dressler Downdraft Intermittent Kilns are available with automatic control of heating and cooling cycles.

Engineered in many types, adapted to the needs of many products and plants, Dressler Kilns continue today the leadership that began with the original Dressler development of the Tunnel Kiln.

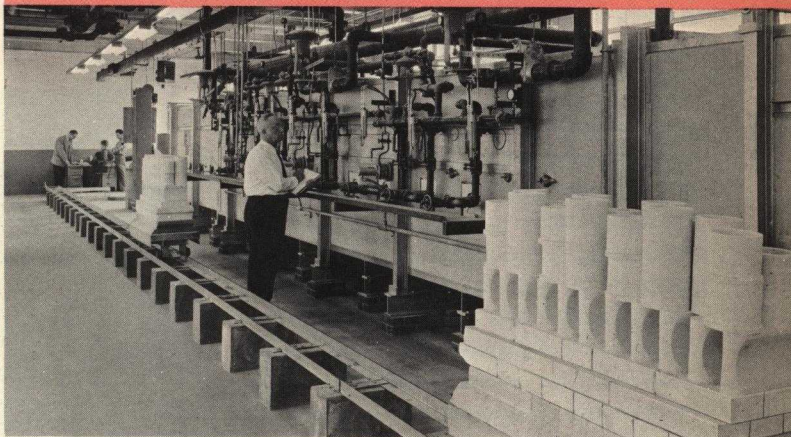
*A method of firing used in Dressler Muffle, Semi-Muffle, Multi-Burner, and other types of direct fired kilns, in which only a minimum of cold air is premixed with the fuel. Approximately 70% of the combustion air is preheated to a high temperature by direct contact with the ware in the cooling zone. The resulting fuel economy ranges from 15% to 50% depending upon the firing temperature—the higher the temperature, the greater the economy.



Dressler Roller Hearth Radiant Tube Kiln for decorating china.

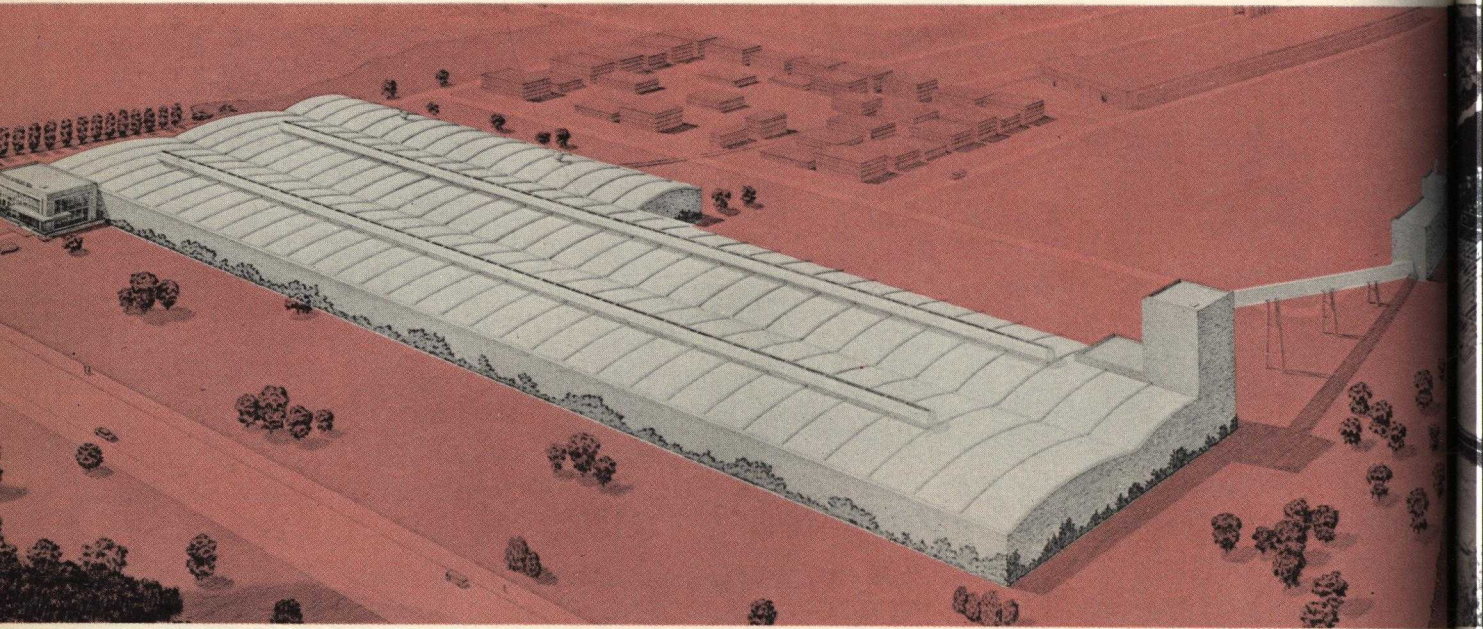


Combination of 236'0" Dressler Semi-Muffle Tunnel Kiln and four (4) Dressler Car-Bottom Kilns for firing abrasives.

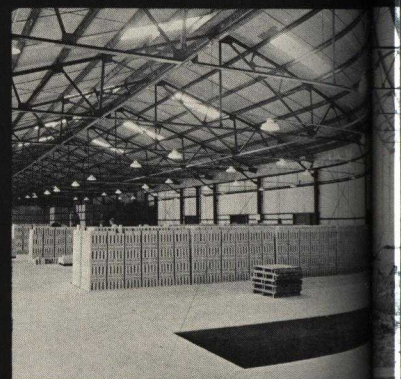
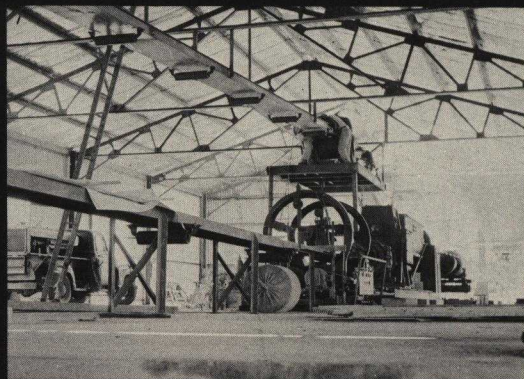
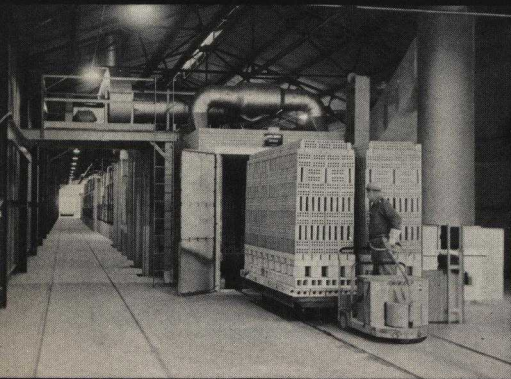


Small section Dressler Recuperative Multi-Burner Kiln for firing high alumina type electronic parts at Cone 33.

Plant Engineering

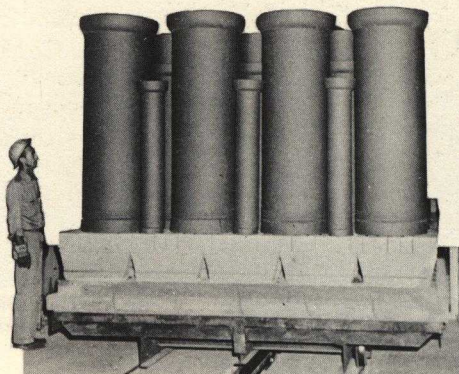


Brick plant developed as part of a Phase 1 study.

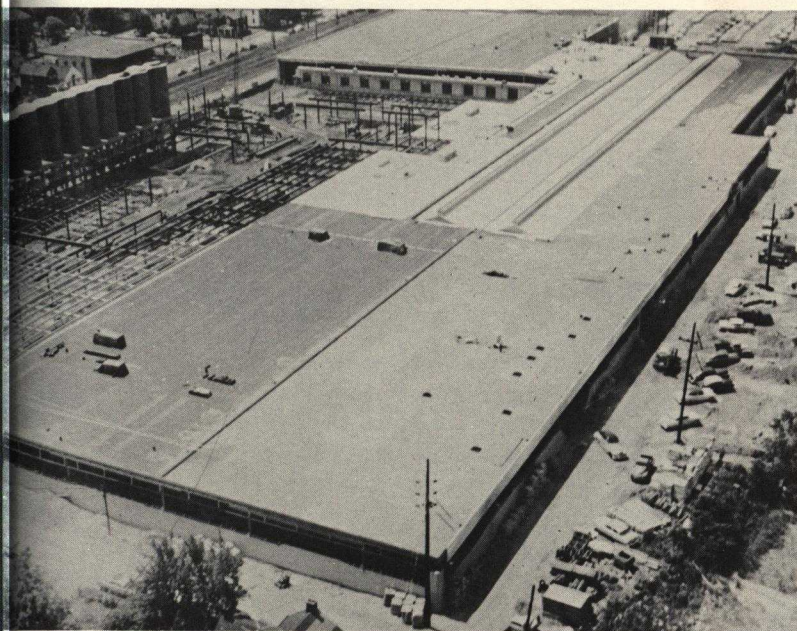


Typical views in plants where Swindell-Dresser

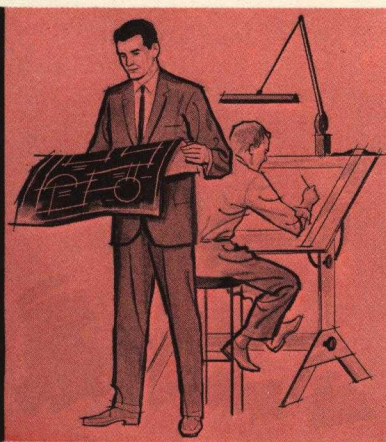
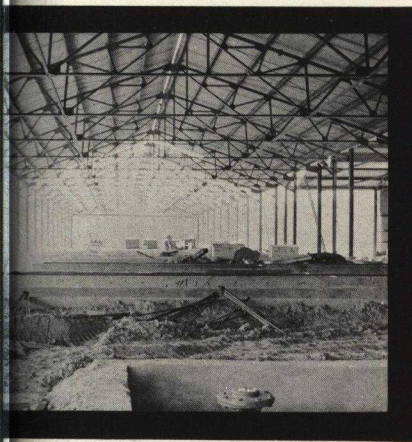
**STRUCTURAL
CLAY PRODUCTS
SEWER PIPE AND
DRAIN TILE
CERAMIC FLOOR
AND WALL TILE
VITRIFIED
SANITARY WARE
ENAMELED
CAST IRON**



for the Ceramic Industry by *Swindell-Dressler*



Sanitary ware plant during construction. All phases performed by Swindell-Dressler.



formed complete service



Swindell-Dressler Corporation provides complete service in plant layout, design and construction supervision for the ceramic industry.

Based upon specialized experience and knowledge of the industry's requirements, our engineering service is offered typically in three basic phases available to the client separately or collectively as the need dictates.

- PHASE 1 applies where plans have not been developed and there is still uncertainty as to the cost of the proposed plant. This phase includes the preparation of a report bringing together sufficient data and cost estimates to present a clear overall picture of the proposed project. In application, this phase enables the client to make decisions regarding continuance of the project or its abandonment for reasons of cost or other pertinent factors.

- PHASE 2 carries the project forward through the layout and design stages to completion of finished plans and specifications for the proposed plant and equipment installations.

- PHASE 3 may follow upon completion of Phase 2 or be undertaken simultaneously. Phase 3 covers management of the entire program including the securing and evaluation of bids, purchasing, payment of the bills and supervising the performance of the contractors. Thus the client is relieved of all coordination activity, purchasing problems and the numerous other details that are an inherent part of any construction program. Phase 3 is especially valuable to the client lacking in manpower facilities and can be a definite aid in expediting the entire construction program.

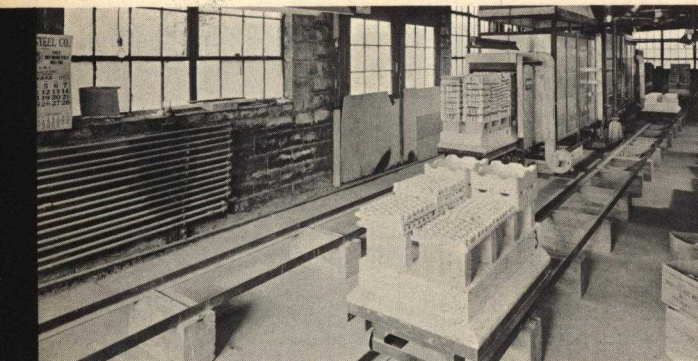
Swindell-Dressler Corporation engineers are specialists in the revamping and rehabilitation of existing facilities and equipment for the purpose of improving the product and at the same time reducing labor costs. Operations are carried out at a minimum of expense, with maximum efficiency and without interfering in any way with normal plant operation.

You are invited to discuss with Swindell-Dressler engineers all aspects of our services in relation to your forthcoming production requirements.

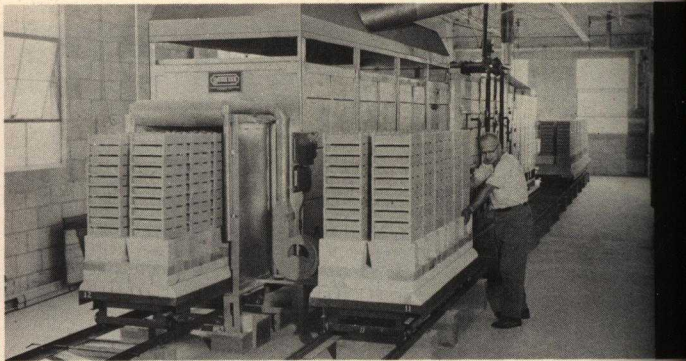
● small in scale

● LARGE IN PERFORMANCE

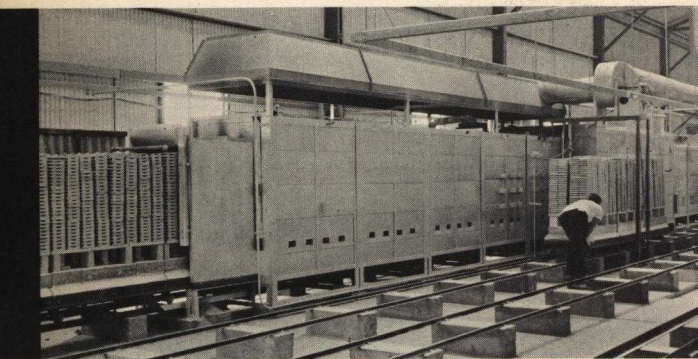
DRESSLER **UNIFAB** KILNS



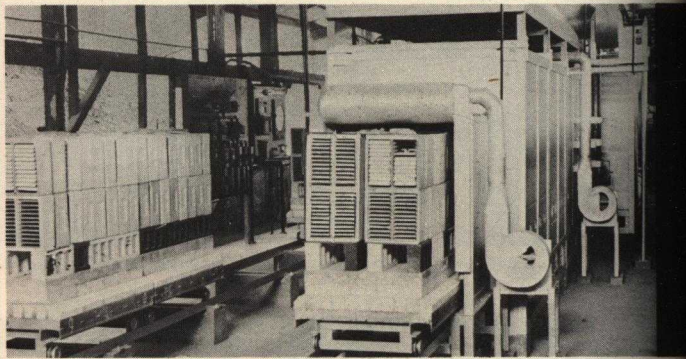
Electrical porcelain, fired in compact Unifab Kiln.



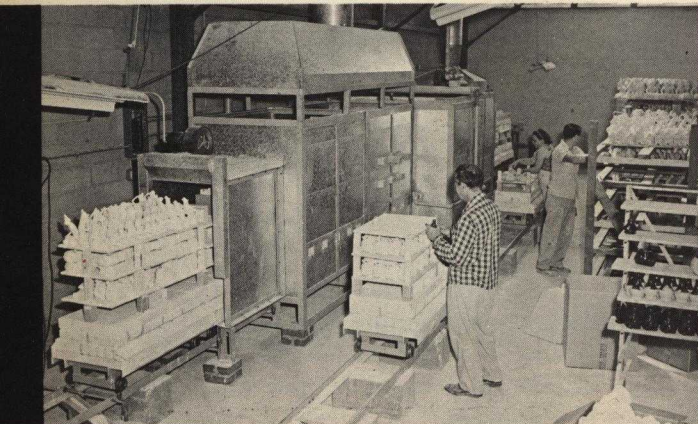
Unifab Kiln firing vitrified ceramic floor tile.



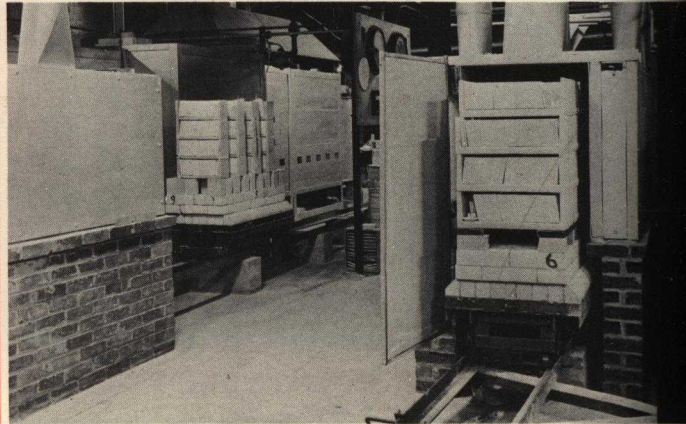
73 ft Type "M" Unifab Kiln, for once-fired glazed wall tile.



Type "O" Unifab Kiln for twice-fired glazed wall tile.



Dressler Unifab Kiln firing artware.



Unifab Kilns producing bisque tile.

Ideal for the smaller plant, and for pilot production in the larger plants, the prefabricated Dressler Unifab Kiln combines compact size with the basic advantages of full-scale Dressler Kilns, and affords lower erection costs, quick installation, low maintenance and long useful life.

Pre-engineered and unit-fabricated, with efficient preheating and cooling sections, the Unifab Kiln provides uniform firing and fast production cycles. Available in standard

lengths from 25 ft to 73 ft, with kiln widths of 13½", 18", 22½" and 27" according to length. Three types: "O"—oil fired, "M"—multi-burner, and "MU"—muffled.

On account of light-weight materials, prefabrication, easy erection and operation, Unifab Kilns are especially adapted for export. They have been shipped to Cuba, Puerto Rico, Panama, Ecuador, Philippines, and elsewhere throughout the world. Write for details.

SWINDELL-DRESSLER CORPORATION

Designers and Builders of Modern Industrial Furnaces

PITTSBURGH 30, PA.

Litho in U. S. A.

F. J. STOKES CORPORATION

5500 TABOR ROAD

PHILADELPHIA 20, PENNA.

Depend on Stokes Equipment for profitable compacting & pressing

For any compacting or pressing job, no matter what the material, no matter what the size . . . you can do it faster and more economically with Stokes equipment. Check these specifications for the right machine to do your job. Ask the man from Stokes for further data—or call on Stokes Advisory Service for application engineering assistance.



Stokes Single Punch Presses

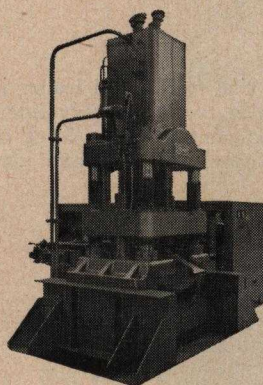
are widely used for pressing insulators and bases for electrical and electronic components, from steatite and porcelain—for grinding wheels—for ferrites—and for titanium, zirconium, and reactive and nuclear materials. A special accessory enables accurate insertion and trimming of pigtails when the piece is compacted. A Model 640 50-ton multiple motion press is shown.

STOKES SINGLE PUNCH MECHANICAL PRESSES														
	A3	E	F	F4	T	T4	R	R4	280G	294	G4	S5	640	
Max. Tonnage	1½	2	4	4	12	12	20	20	100	60	15	40	50	
Max. No. of Press Motions	1	1	1	3	1	3	1	3	2	2	3	3	5	
Max. Diameter	½	½	¾	1¼	2	2	3	3	4	4"x6"	2½	3	4	
Max. Depth of Fill	⅞	½	1½	1¼	1¼	1¼	2	2¼	4	2½	4	6¼	4	
Tablets/minute	40-75	85-130	60-95	25-55	20-60	12-48	16-48	15-45	8-24	20-55	12-36	10-30	8-32	



Stokes Rotary Presses

are primarily used where high production rates and long runs of a single shape or a few shapes are required. Special units are available for pressing thin ceramic discs for capacitors and thermistors. The machine illustrated is a Model 540 4-ton rotary press with hydraulic pressure controls.



Stokes Hydraulic Presses

are generally used where large pieces and heavy tonnage is required, such as grinding wheels and large compacts from refractory metals. A standard Model 713 300-ton dual pressure hydraulic compacting press is shown.

STOKES ROTARY PRESSES										
	B2	BB2	540	D3	DS3	533	DD2	DDS2	230	210
Max. Tonnage	4	4	4	7	10	10	15	15	30	100
Max. Diameter	¾	¾	¾	1½	1½	1½	1½	1½	2½	2½
Max. Depth of Fill	1½	1½	1½	1½	1½	1½	1½	1½	4½	5
No. of Stations	16,22	27,33,37	35,41,51	16	15	27,33	19,23,31	19,23	10	12
Tablets/minute	350-890	750-1900	750-3750	190-350	180-335	700-2500	200-975	100-360	65 or 91	72 or 96

STOKES SINGLE STATION HYDRAULIC PRESSES									
	705	711	712	713	715	714			
Max. Tonnage	57	106	200	321	545	100	200	300	500
Max. No. of Press Motions	5	5	5	5	5	3	3	3	3
Max. Diameter	6	8	10	12	14	6	6	7	8
Max. Depth of Fill	10	10	10	8	14	5	6	6	8
Max. Cycles/minute	7	8	10	10	3	6	6	5	4

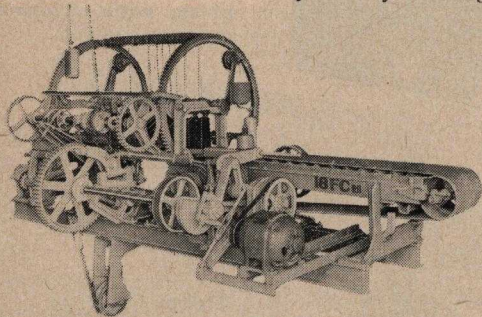
Powder Metal Press Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

**SINCE
1889**

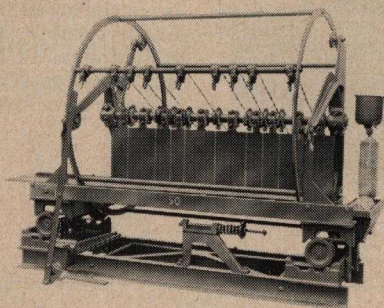
J. C. Steele and Sons, Statesville, N. C.

**has produced dependable, economical, and long lasting
Clay Working Machinery**

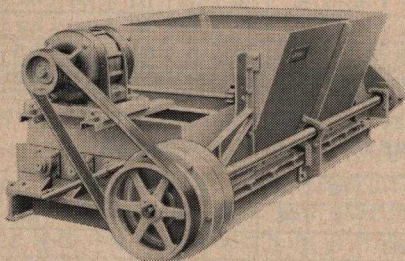
Steele Equipment is characterized by rugged construction and extreme simplicity of design. Almost seventy years of service to the clay working industry and careful testing of each new unit under commercial working conditions is your assurance that each Steele unit will perform exactly as claimed. All Steele equipment is so generously constructed that overloading of any vital part is practically impossible. Steele has accurate part records of every machine produced. This, coupled with large stocks of repair and replacement parts, guarantees quick service on wearing parts. Expert engineering service is available on special problems. Call on J. C. Steele & Sons for all your clay working needs.



No. 18 Brick and Tile Cutter. The undisputed leader in the brick and hollow tile field. Ten types of easily interchangeable cutting reels adapt it to cut any type brick or tile. Rigid construction assures easy operation and long service.



No. 50 Hand Cutter. Excellent for high quality face tile, rectangular flue linings or delicate columns. Easily handles ten cuts per minute on columns up to 14" x 14".

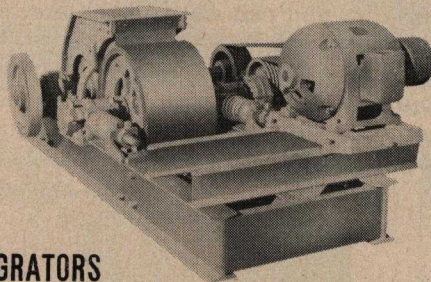


Spiral Even Feeders. Large hoppers, steep sides and positive force of spiral shafts eliminate arching, bridging, choking, gorging, and starving. Built in three sizes:

88-C (shown here). A four shaft feeder used in hundreds of plants for feeding moist clays and/or ground and screened materials fed up to about 80T/hr.

44-C. A two shaft feeder *excellent* for feeding ground and screened material at up to about 40T/hr.

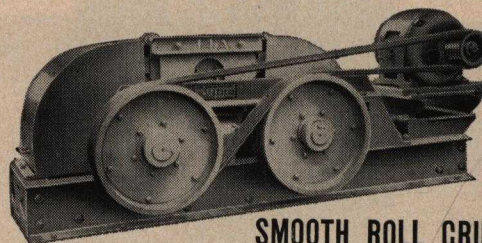
Double-88. An eight shaft feeder with two drives. Capable of feeding *extremely* wet clays and other very sticky materials. Provides tremendous storage capacity above extremely large positive feeding area.



DISINTEGRATORS

These are direct acting roll type crushing machines used for primary reduction of many different types of materials. Excellent for crushing soft surface clays. Excellent for crushing hard clays and the softer varieties of shales. Frequently installed to reduce loading on dry pans or grinders. Maintenance costs lower than for nearly any other type of crushing machine. Three sizes built:

No. 6A (shown here) - No. 4A - No. 2.



SMOOTH ROLL CRUSHERS

These crushers are primarily designed for the fine grinding of surface clays. They are also quite useful for fine grinding of the softer varieties of shales and fire clays. Many are used successfully for crushing harder materials such as cinders and other aggregate. Roll crushers are considered to be the only practical crushing machines for moist sticky clays. Three sizes are available:

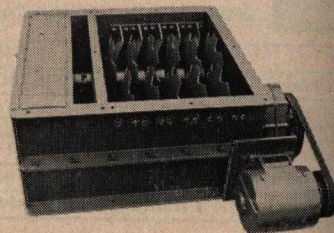
No. 14A (shown)—particularly adapted for harder materials.

No. 18—recommended for heavy tonnages of soft clays.

No. 12—recommended for moderate tonnages of soft clays.

WASTE CHOPPER

The first fully engineered machine of its kind for reducing green waste to minus 2 inches before return of the waste to the production line. Prevents build up and clogging of scrap conveyors. Improves quality of end product.

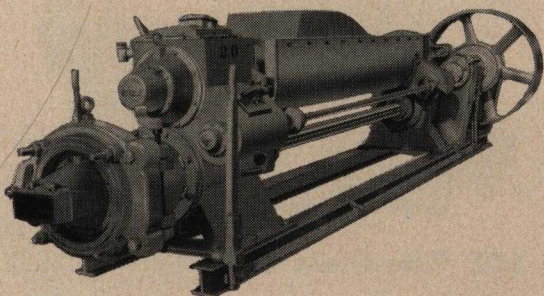


Steele DeAiring, Pugging & Extruding Equipment

STEELE offers the most complete line of types and sizes of deairing, pugging and extrusion machines on the market. There are seven basic sizes. These provide for a range in production of (rated in U. S. standard brick) 2,000 to well above 20,000 brick per hour of continuous operation. These machines are available in three basic designs:

Combined Pugging & DeAiring Extrusion Machines

Three basic sizes provide production range from 2,000 to over 15,000 brick per hour of continuous operation.



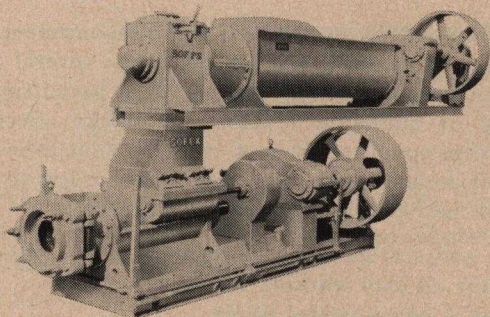
No. 20E (shown here)—capacity 2,000 to 5,000 brick per hour.

No. 30E—capacity 4,000 to 8,000 brick/hr.

No. 40F—capacity 8,000 to 15,000 brick/hr.

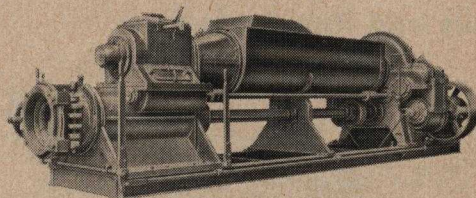
Separate Drive Machines

The advantages of completely separate control over the functions of pugging-sealing and extruding are widely recognized. Three basic sizes are available:



No. 50F Separate Drive (shown)—capacity 8,000 to 18,000 brick per hour.

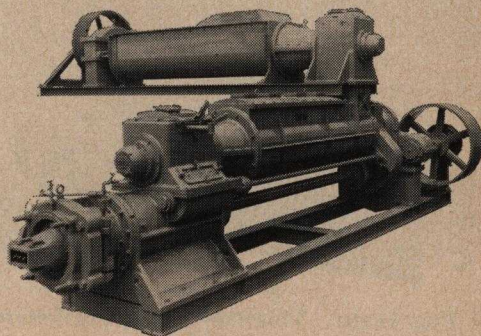
No. 70F Separate Drive—providing the largest pugging facilities and the highest extrusion capacity. Capacity above 20,000 brick per hour.



No. 60F Separate Drive Combined Type (shown above)—the newest and most advanced machine on the market. Provides compactness of combined type design while actually using completely separate drive for the functions of pugging-sealing and extruding—both through extremely heavy double reduction gearing.

Vacuum Pugging & Vacuum Extrusion Machines

Steele has pioneered in developing vacuum pugging machines. Pugging under vacuum produces the ultimate in effective deairing. The following standard models offer vacuum pugging in addition to conventional open pugging:

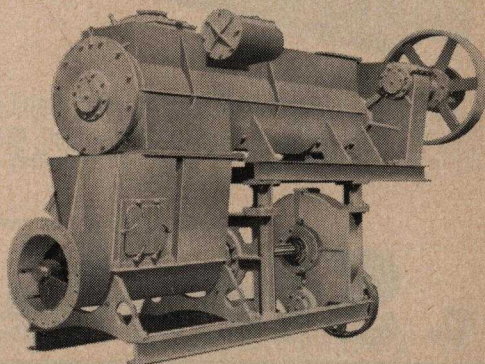


No. 40FV (shown) being fed with 50F Pug Sealer.

No. 50F Separate Drive Machine—available either with **No. 50FV** Vacuum Pug Sealer or **300FV** Vacuum Pugmill in addition to conventional pug sealer and extruder.

No. 60FV (would be fed with 50F Pug Sealer)

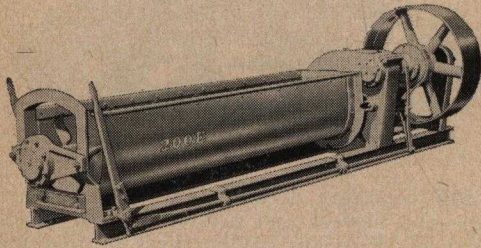
No. 70F. Vacuum pug sealer or vacuum pugmill in addition to 70F Pug Sealer and 70F Extruder.



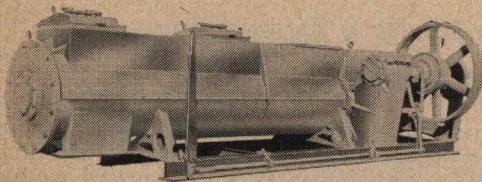
No. 300EV Vacuum Pugmill and Intermittent Pipe Press Feeder.

Steele DeAiring, Pugging & Extruding Equipment

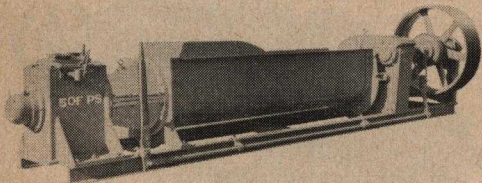
Pugmills and Pug Sealers



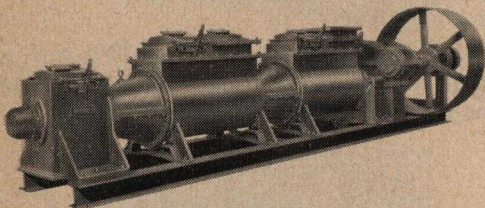
No. 200E Open End Pugmill. This is one of several sizes of heavy duty roller bearing Open End Pugmills.



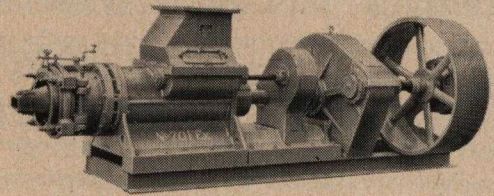
No. 300FV Vacuum Pugmill. Produces fine texture and reduces lamination. Greatly increases plasticity in many materials.



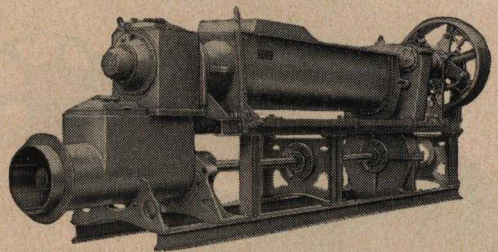
No. 50F Pug Sealer. This model and the heavier 70F provide thorough pugging, compressing, and shredding. An extremely versatile machine. Also made in Model No. 50FV for pugging under vacuum.



No. 50F Double Vacuum Pug Sealer. Designed to develop plasticity in an otherwise extremely short material. An example of Steele flexibility to meet unusual conditions.



No. 70F Extruder. This is the largest Steele Extruder, with tremendous gears, shafts, and bearings for the very heaviest jobs. Capacity over 20,000 bricks per hour. Four other sizes made. Dies available for any type brick or hollow tile.



No. 50E Pipe Press Feeder

24 Hour Service on Working Parts

Standard wearing parts are carried in stock. Your order for them is on the way to you within 24 hours after receipt. Even special wearing parts for any Steele Machine, with the exception of those which require special alloys or reel parts made to your special measurements, are shipped within 72 hours. In emergencies our entire plant is at your disposal.

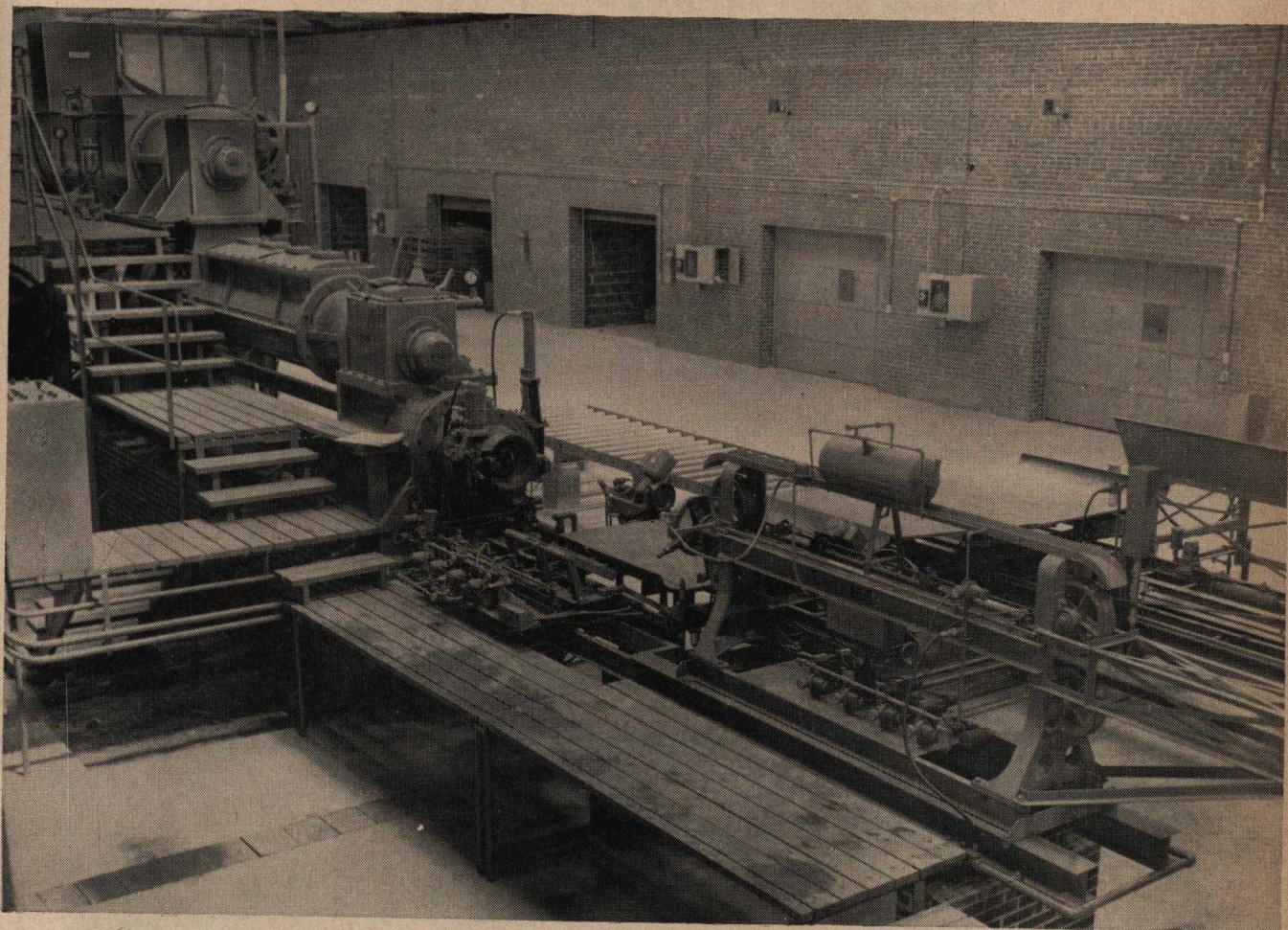
Two additional factors make Steele's replacement service especially flexible. Many parts of the several Steele machines are interchangeable — thus permitting the carrying of minimum replacement stocks. Secondly, Steele keeps complete plans of every machine ever made, to permit double-checking of repair part orders to make sure that you get the right part.

Quality and service combine to make Steele your best source for all clay working machinery.

J. c. Steele & SONS Statesville, N. C.

• THE BEST IN CLAY MACHINERY SINCE 1889 •

Steele Supplies Complete Pipe Installations



(Shown here is a new line of Steele machinery in a pipe plant which has used Steele equipment for over thirty years. Photograph was taken April 15, 1957 just before the new line went into production.)

It's *All Steele* From upper left to extreme right are:

Steele Auto Compensating Water Spray Assembly

Steele 50-F Pug Sealer delivering pugged, sealed and shredded clay into a

Steele 40-FV Vacuum Pugging and Vacuum Extruding Machine delivering pipe to

Steele Automatic Off Bearer, Automatic Former, Automatic Finishing Machine, and
Automatic Pallet Loader

In addition to this type of equipment for the horizontal auger extrusion of pipe, Steele also makes vacuum pugging and feeding machines for use with vertical presses. We will be glad to give you full information on this and other outstanding Steele equipment.

Pacific Agents: Walter C. Stoll, 5028 Alhambra Ave., Los Angeles 32, Calif.

J. C. Steele & Sons Statesville, N. C.

● THE BEST IN CLAY MACHINERY SINCE 1889 ●

STURTEVANT MILL COMPANY

6 Harrison Square, Boston, Mass.

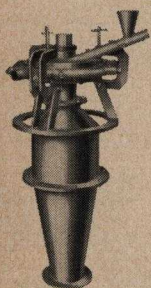
Reduction, Separating, Conveying and Processing Machinery

Jaw Crushers
Rotary Fine Crushers
Crushing Rolls
Hammer Mills
Ring Roll Mills

Rock Emery Mills
Laboratory Machines
Vibrating Screens
Mechanical Air Separators
Bale Pulpers, Paper

Mixers
Dry Batch
Dustless Batch Blenders
Den and Excavator
Elevators

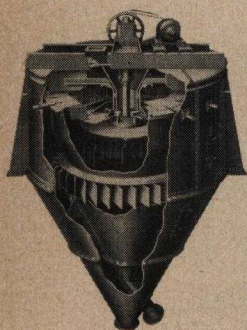
Services: Consulting, Designing and Erecting Engineers



Micronizer® Grinding Machine

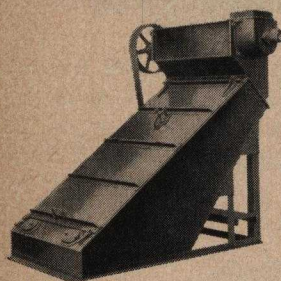
A fluid jet grinding machine, the Sturtevant Micronizer speeds reduction of materials to low micron sizes. These jet mills are especially applicable in fields where a particle size in microns is desired.

Sturtevant Micronizer grinders are available in many sizes and capacities.



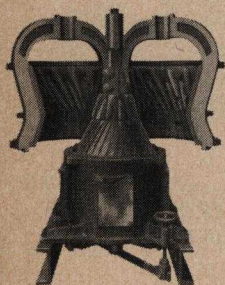
Air Separators

for finest separation of dry materials. Range of work 40-400 mesh. Capacities $\frac{1}{4}$ ton to 50 tons per hour. Large feed opening, steep cones, rigid construction, Ball and Roller bearings. Small power, low upkeep, easy adjustments. Sizes: 3' to 18'.



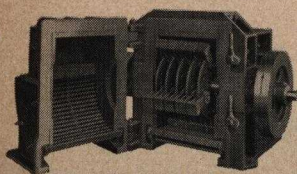
Moto-Vibro Screens

screen anything screenable. Classified vibrations. Unit construction—any capacity. Open door accessibility. Open and closed models with or without feeders. Many types and sizes range of work $\frac{1}{2}$ " to 60 mesh.



Rotary Fine Crushers

for intermediate and fine reduction. ($1''$ to $\frac{1}{4}''$.) Open door accessibility. Soft or moderately hard materials. Efficient granulators. Excellent preliminary Crushers preceding Pulverizers. Many sizes. Belt or motor driven.

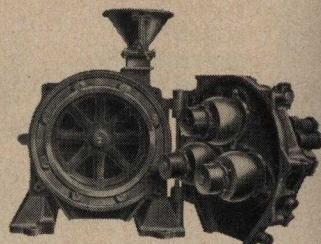


Swing-Sledge Mills

for coarse and medium reduction. ($1''$ to 20 mesh.) Open door accessibility. Soft, moderately hard, tough or fibrous substances. Built in several types and many sizes.

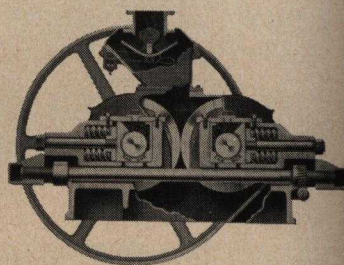
Ring Roll Mills

for medium and fine reduction (10 to 200 mesh) hard or soft materials. Very durable, small power. Operate in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes, large or small capacities. No scrapers, plows, or shields.



Crushing Rolls

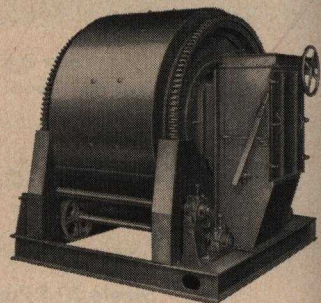
for granulation, coarse or fine, hard or soft materials. Precision and automatic adjustments. Crushing shocks balanced. For dry or wet reduction. Sizes 8x5 to 38x20. Roller or Plain bearings. The standard for abrasives.



Dry Batch Mixer

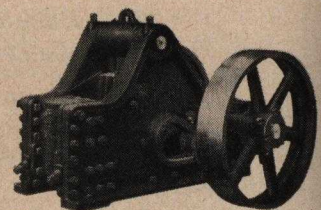
for intimate blending. Batch type. One opening only for intake and discharge. Open door accessibility. Many sizes, $\frac{1}{4}$ to 2 tons — Large outputs, Simple, Compact, Easy Running, Practically Dustless. With or without batch hoppers.

Also Dustless Batch Blenders.



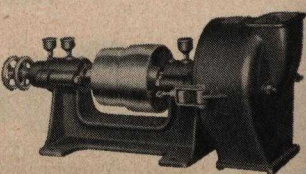
Jaw Crushers

for coarse, intermediate and fine reduction of hard or soft substances. Heavy or light duty. Cam and Roller action. Special crushers for Ferro-alloys. Several types, many sizes.



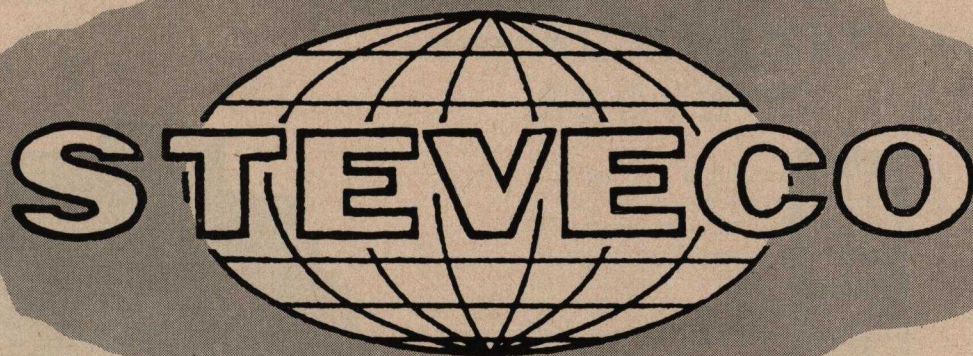
Laboratory Machinery

Jaw and Rotary Crushers, Rolls, Hammer Mills, Disc Pulverizers, Screens, Air Separators, Coal Crusher and Sampler, Vibrating Test Sieves.



Open-Door Elevators, Conveyors, Bins, Chutes, Spouts, Special Machinery Built to Order

STANDARD OF THE WORLD



IN PROCESSING EQUIPMENT

- **AGITATORS • PRESSURE VESSELS**
- **MIXERS • BALL MILLS**
- **SCREENS**
- **CLAY WORKING MACHINERY**

INCLUDING PANS, PRESSES, CRUSHERS

**SAVE TIME
and MONEY**

**BUY STEVECO REPLACEMENT
PARTS FOR ALL MAKES OF MACHINES**

THE STEVENSON COMPANY

WELLSVILLE (ZONE 1, OHIO)

SALES REPRESENTATIVES IN PRINCIPAL CITIES

THE STEVENSON COMPANY

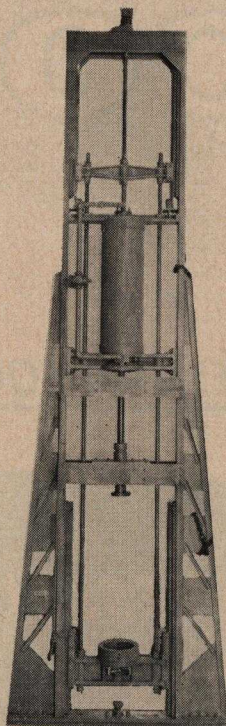
WELLSVILLE (ZONE 1), OHIO

SALES REPRESENTATIVES IN PRINCIPAL CITIES

STANDARD OF THE WORLD



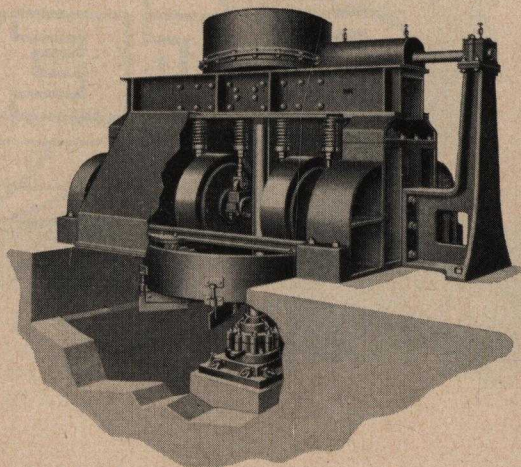
IN PROCESSING



STEVECO MECHANICAL OR STEAM OPERATED PRESS

For pressing ranges up to 20" wide with clearances of 5'0" from die holder to spinner head.

For further information write, wire or phone.



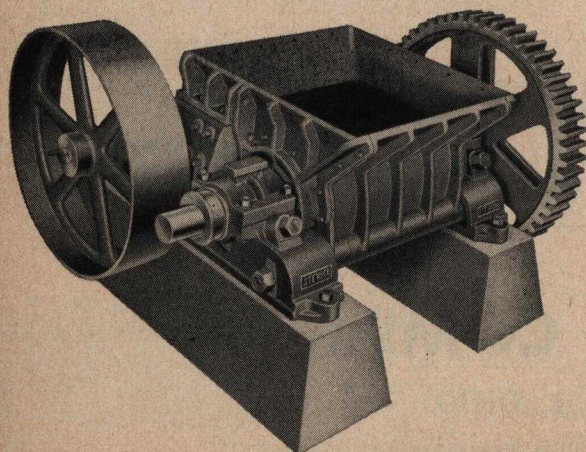
STEVECO DRY GRINDERS, WET GRINDERS AND MIXING PANS

All new and proven models of highest efficiency, operating with low power and maintenance costs.

Both rim and screen discharge with V-Belt and direct drive operating on Timken anti-friction bearings from 3'0" to 10' in diameter, ranging in grinding capacity up to 80 T.P.H.

SIZE	GRINDING CAPACITY	DIMENSIONS	
5'8"	8 to 15 T.P.H.	13'8 1/2" x 7'5" x 7'8"	High
7'0"	40 to 80 T.P.H.	13'10" x 9'10" x 9'7"	High
9'0"	10 to 15 T.P.H.	16'7" x 9'10" x 7'7"	High
9'0" H.D.	25 to 30 T.P.H.	14'10" x 8'1" x 7'7"	High
10'0" H.D.	30 to 50 T.P.H.	17'9" x 10'4" x 8'10"	High

For quotations on this efficient new equipment, write, wire or phone today.



STEVECO ANTI-FRICTION SINGLE ROLL CRUSHER

Efficient low cost crushing for primary reduction of clays, shales and other materials. One piece steel roll and steel breaking plate with renewable crushing liners.

Model	Size	Size Cubes	Estimated Capacity Tons per hour	Estimate H. P.	Height Above Foundation	Length Overall	Width Overall
A-347	18 x 30"	2 1/4"	30 to 50	20 to 25	3'-4 11/16"	7'-3 1/16"	7'-5"
"	18 x 36"	"	40 to 60	25 to 30	"	"	7'-11"
"	18 x 42"	"	45 to 70	30 to 35	"	"	8'-6"
A-339	24 x 30"	"	75 to 125	40 to 50	4'-6 9/16"	9'-1 11/16"	7'-9 1/4"
"	24 x 39"	"	100 to 150	50 to 100	"	"	8'-8 1/4"
"	24 x 48"	"	125 to 175	65 to 125	"	"	9'-5 1/4"
A-360	24 x 39"	"	100 to 150	50 to 100	"	9'-2 5/32"	9'-8 1/8"
"	24 x 48"	"	125 to 175	65 to 125	"	"	10'-5 1/8"

Send us your requirements. Your request will be handled promptly.

THE STEVENSON COMPANY

WELLSVILLE (ZONE 1), OHIO

SALES REPRESENTATIVES IN PRINCIPAL CITIES

STANDARD OF THE WORLD



IN PROCESSING

BUY ONLY GENUINE STEVECO PARTS

To get the highest performance at all times from your STEVECO Machine, *always* buy genuine STEVECO Replacement Parts. Each STEVECO Replacement Part is made to the same exact tolerance and of the same quality material as the original part. These parts enable you to RENEW the high performance originally engineered into your STEVECO Machine.

As improvements in material and design of important parts are proved through actual service, they are offered for replacement on all older models. STEVECO is constantly searching for better materials, and is engineering better performance into STEVECO Machines to give you longer use before wear demands replacement of parts, and to insure smoother, easier running to further reduce power requirements and your production costs. Parts subject to greatest wear due to direct contact with abrasive materials, are kept in stock. Other parts can be manufactured to the original specifications, on short notice.

Save **TIME**
and **MONEY**

BUY STEVECO REPLACEMENT PARTS
FOR ALL MAKES OF MACHINES

Muller Tires
Screen Plates
horizontal slots
vertical slots
winter (diagonal) slots
($\frac{1}{8}$ to $\frac{3}{8}$ inch)
—larger if needed
Scrapers
Scraper Heels
Scraper Liners
False Plates

Crusher Roll Teeth
Grate Bars
Gears
Bearings (ROLLER) for
drive shafts
roller type step bearings
vertical shaft roller bearings
muller shaft roller bearings
Pan Arms
Axle Boxes
Roll Bushings

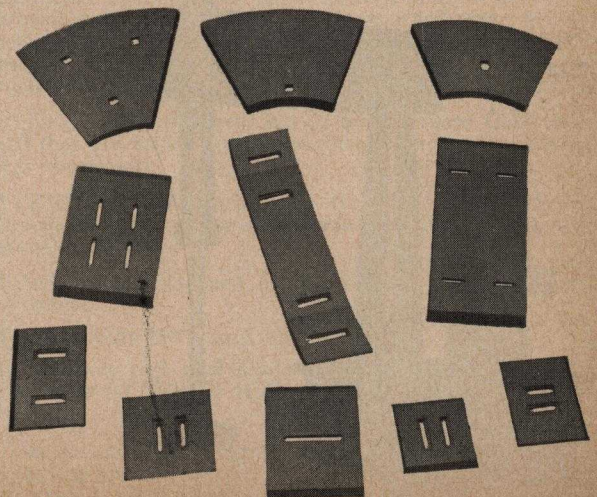
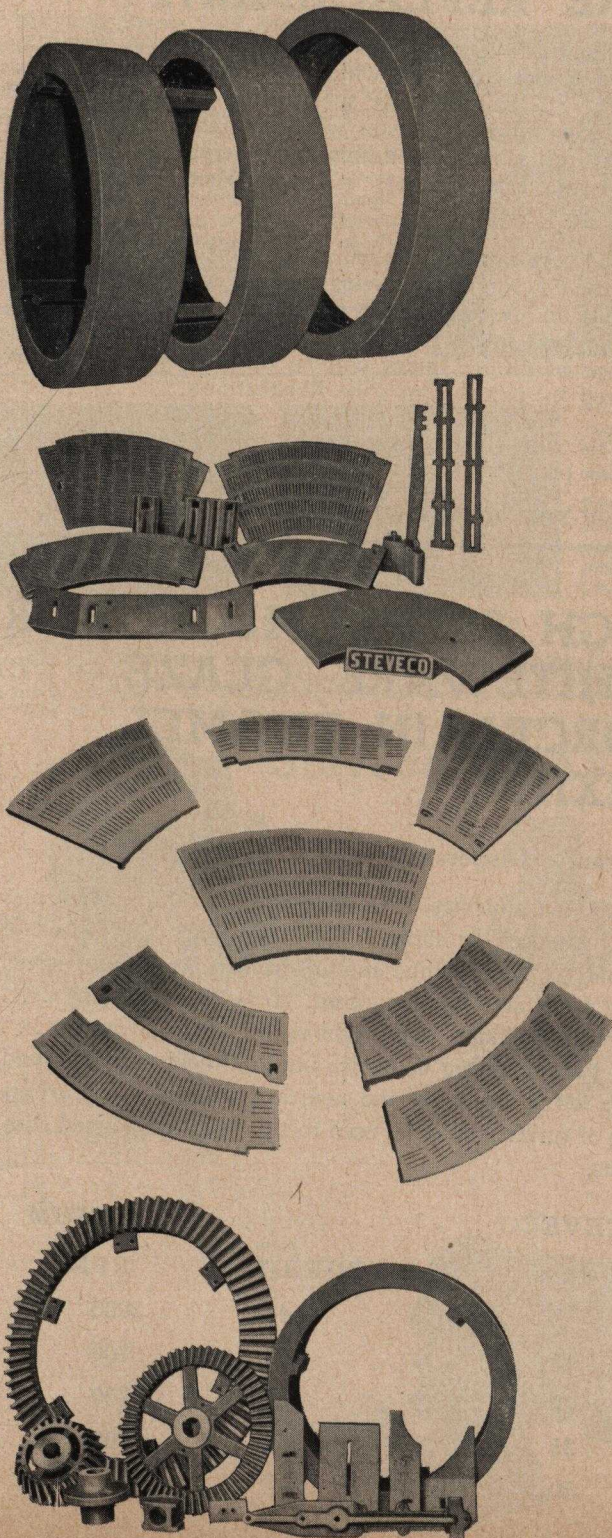
Available in the following abrasion resisting alloys:

Cast Iron
STEVECO SS Alloy (Nickel)
STEVECO High Tensile Alloy
STEVECO Everwear

STEVECO Ni-Hard
STEVECO Ductile Iron
STEVECO Meehanite Iron
STEVECO Mallix Iron

Write or wire for prices and specific quotations.

CONVERT THE BABBITT OR BRONZE BEARINGS ON YOUR OLDER MODEL MACHINES TO NEW ROLLER TYPE ANTI-FRICTION BEARINGS



THE STEVENSON COMPANY

WELLSVILLE (ZONE 1), OHIO

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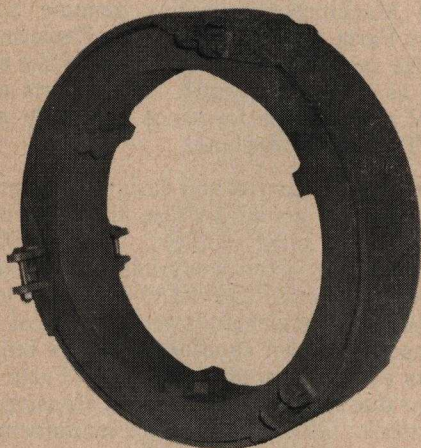
STANDARD OF THE WORLD



IN PROCESSING

SAVE 75% — MULLER TIRE COSTS

NEW SEGMENT MULLER TIRE REPLACEMENT



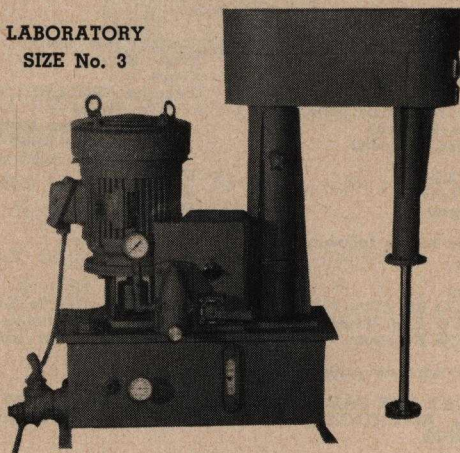
The Stevenson Company has now developed a new segmented muller tire liner, which will reduce your costs by at least 75% or more. By substituting Steveco liners for hard face muller tires, you will eliminate replacing your muller tires, as well as eliminating welding hard facing on these tires. Life of liners will equal that of hard facing $\frac{1}{2}$ " thick.

Entire liners can be installed at the time new muller tires are replaced, simply by raising the muller 6" off the grinding plate and bolting the three sections together. Assembly time for both mullers will take no longer than four hours. Linkage of muller liners will be internal or external as required by pan design (see illustration).

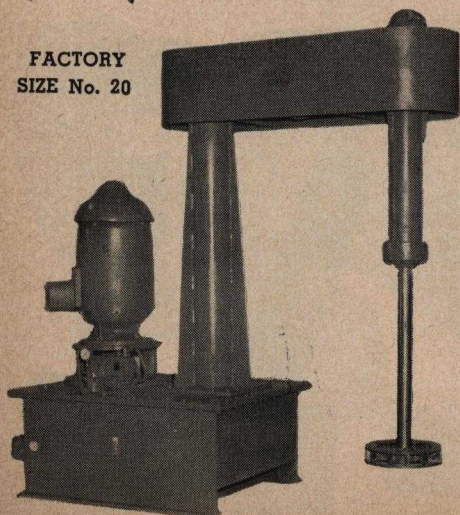
The Stevenson Company can furnish liners for all wet and dry pans throughout the industry.

Write today for additional information on your particular type liners.

LABORATORY
SIZE No. 3



FACTORY
SIZE No. 20



HIGH SPEED MIXER FOR WHITEWARE, GLAZE, PORCELAIN ENAMEL MIXING

Hydraulic Disperser

Dissolves, Emulsifies, breaks up agglomerations, disperses with highspeed or shear action depending upon speed of turbine . . . Hydraulic motor drive with infinite speed range from zero to maximum, no belts or gearing . . . Hydraulic cylinder, any height up or down movement . . . Only two operating controls: one for turbine shaft speed —one for up or down and neutral positions . . . Various types of turbines may be used to suit your specialized conditions.

STEVECO

MAXIMUM

NO.	H.P.	TURBINE	RPM
3	3	4"	2000
15	15	15"	700
20	20	15"	700
25	25	20"	700
30	30	24"	700

THE STEVENSON COMPANY

WELLSVILLE (ZONE 1), OHIO

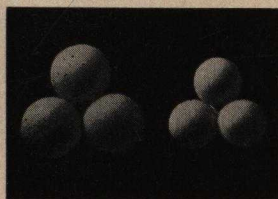
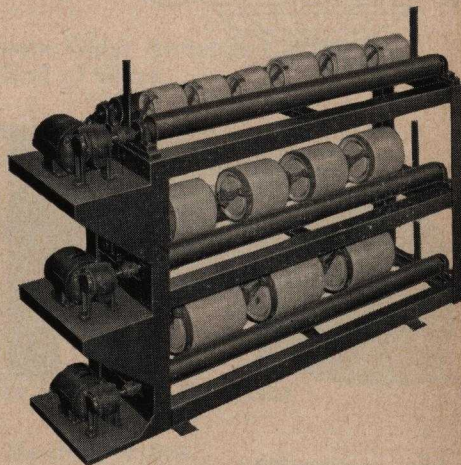
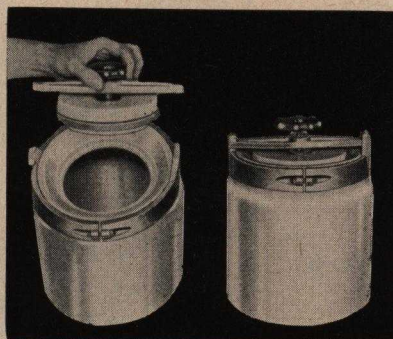
SALES REPRESENTATIVES IN PRINCIPAL CITIES

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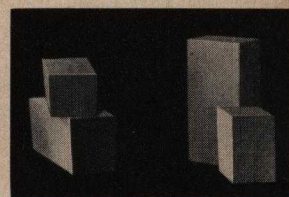
● STEVECO HEAVY DUTY 1, 2- & 3- TIER LABORATORY ROLLER MILLS

STEVECO Heavy Duty Laboratory Roller Mills are manufactured in 1-tier, 2-tier, and 3-tier Models. Each tier is individually driven by a gear-motor and may be run independently. All tiers will accommodate any size or combination of sizes of jars from 1 pint capacity to 4 gallons capacity. Simple design; very sturdy construction. Available with single phase or three-phase motors. Steveco Porcelain Jars have patented "Twist-of-the-Wrist" lid seal, bronze hardware, and gasket. Pint and quart sizes have screw-clamp lid seals. Stopper type jars also are available. In colors; glazed or unglazed finish.



Flint Pebbles;
Porcelain or High-
Density Balls,
Round or Elliptical

Porcelain, High-
Density, or Buhr-
stone Lining—
with and without
Lifter Bars



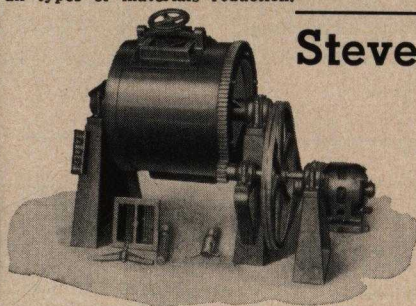
STEVECO HIGH GRADE BALLS AND PEBBLES

STEVECO Balls and Pebbles are available in graded sizes. Hard porcelain and high-density balls may be purchased in your choice of round or elliptical shapes. Flint pebbles also are available. Suitable for use in all types of ball mills, pebble mills, and laboratory mills, for all types of materials reduction.

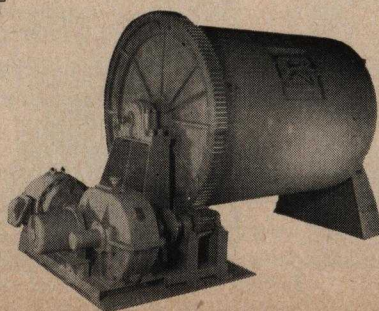
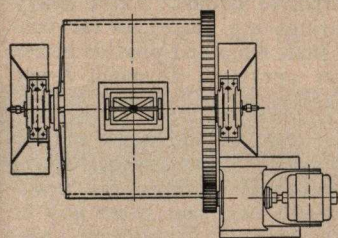
EXPERT STEVECO MILL RELINING SERVICE

Let STEVECO technicians reline your present ball and pebble mills for greatly extended useful life of these machines. STEVECO Hard Porcelain, High-Density, or Buhrstone, carefully fitted by these experts, puts your mill back in NEW condition, ready for full production again.

Steveco HEAVY DUTY Ball & Pebble MILLS



The finest bearings—like these—reduce friction, wear, and make it possible to use MUCH less power to do the job. They make every STEVECO Mill a better buy for you!



Select the sizes you need from the full line of STEVECO Ball and Pebble Mills—made of any steel alloy specifications—with full linings of hard porcelain, high density, or buhrstone, in all sizes from 15 x 21 inches to 8 x 10 feet, jacketed or un-jacketed, and with direct, chain, or V-belt drive. Famous for more than a Century for rugged construction, low power requirement, and low maintenance cost.

SUPERIOR STEVECO FEATURES:

Compared with ordinary babbbitted bearings, STEVECO ROLLER Bearings offer power savings of 15 to 25%. They provide a fixed relationship between gear and pinion and their self-aligning feature prevents settling of one into the other—and they are easier to maintain. ALL STEVECO Heavy Duty equipment is equipped with similar ROLLER type bearings.

STEVECO big ring gear has 35 to 50% more CUT teeth—and they are large. Result—smoother running, less vibration, less horsepower.

STEVECO jacket construction extends from head to head. Result—more heat transfer surface, sounder construction, better appearance.

Fabricated grinding and discharge doors are lighter, easier to handle.

Two air vents 180° apart, are standard.

Extra-heavy cast steel heads permit shells to be welded all around on STEVECO Mills. Result—no rivets, no caulking, no leaks.

Trunnions are cast integrally with heads and shells are rolled from one extra-heavy piece . . . specially rounded lifter bars are used . . . High-Density mill linings have built-in lifter bars.

THE STEVENSON COMPANY

WELLSVILLE (ZONE 1), OHIO

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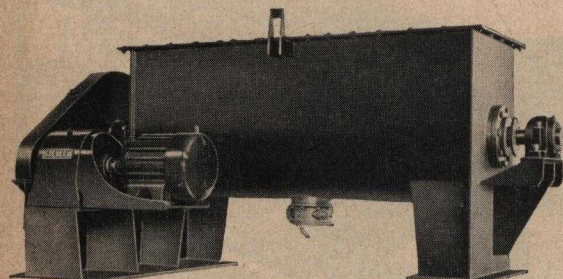
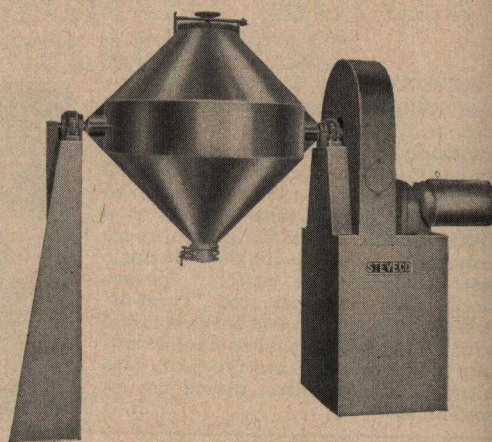
STANDARD OF THE WORLD



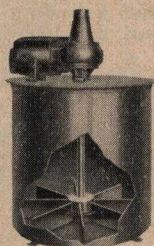
HEAVY DUTY MIXING AND BLENDING EQUIPMENT



The finest self-aligning anti-friction roller bearings and journals obtainable are used in all Steveco-Standard heavy duty equipment.



- agitators
- blungers
- portable mixers
- slip tanks
- pressure tanks
- storage tanks
- processing mixers (jacketed or unjacketed)



STEVECO
STANDARD
OF THE WORLD

RIBBON MIXERS AND DRY BLENDERS

STEVECO Machines are Standard of the World for all dry mixing and blending operations. Sizes range from $2\frac{1}{2}$ to 150 cubic feet capacity, making it easy to select the exact model suited to your particular needs. Such outstanding features as self-aligning heavy-duty roller bearings; cut gear teeth on gear-driven models; corrosion and abrasion resisting alloys at all points in contact with materials; modern purpose-conscious engineering to help you reduce production costs—all contribute to less downtime for repairs, appreciably longer life, and MUCH LOWER power requirements for the operation of the individual machine.

There is a STEVECO Heavy Duty Mixer for every purpose and in every size you need. All STEVECO Mixers are engineered for rugged duty under the most exacting conditions. Grease seals are provided to prevent product contamination, lock in lubricants and lock out dust, grit, fumes, or corrosive liquids. Extra heavy duty anti-friction roller bearings are placed as far outboard as possible to prevent shaft whip and provide better control and smoother, faster operation at much lower power requirements for the job.

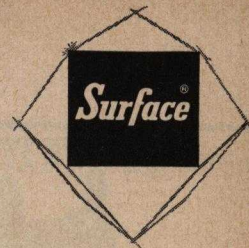
Propellers, paddles, stirrers, and various types of impellers with or without baffles, and in many special alloys and abrasion or corrosion resisting coatings, are available. STEVECO engineers will help you select any of these special styles, materials, or finishes you may need.

STEVECO Heavy Duty Tanks may be ordered in a wide range of abrasion resisting alloys and finishes. Models are available in both plain and jacketed types with open tops or fully pressurized. STEVECO engineers will gladly recommend the correct standard or special-purpose model best suited to your exact requirements.

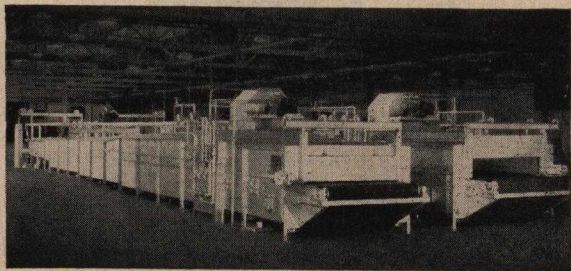
STEVECO screen sizes range from 10"x20" to 36"x72" designed with minimum number of wearing parts. Can be furnished in carbon steel or stainless steel, open, totally enclosed on exp. proof drives.

SURFACE COMBUSTION CORPORATION

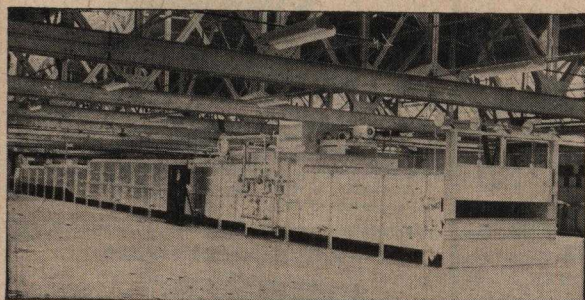
2370 Dorr St., TOLEDO, OHIO



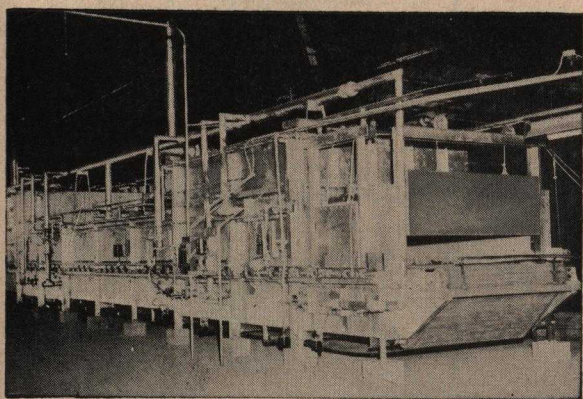
Heating and Heat Treating Equipment for Ceramics



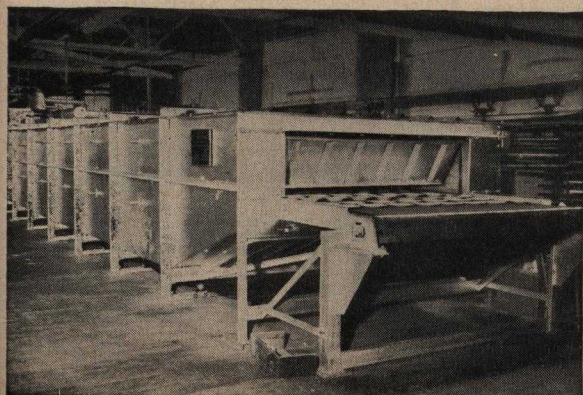
Continuous Annealing and Decorating Lehrs



Continuous Annealing Lehr



Convexing and Bending Furnace



Radiant Tube Pottery Decorating Kiln

- ★ Continuous Glass Annealing Lehrs for Every Kind of Glass
- ★ Continuous Convexing and Bending Furnaces
- ★ Continuous Decorating or Reannealing Lehrs
- ★ Continuous Conveyor Type Pottery Decorating Kilns
- ★ Furnaces for Special Processes
- ★ Mould Heating Ovens
- ★ Lehrs for Heat Treatment of Television Tubes

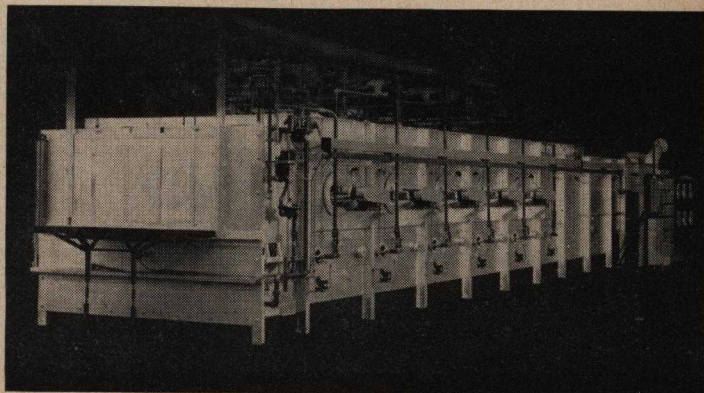
*Research, Development,
Engineering, Manufacturing, Service*

Many of the major furnace improvements for the heating processes have been developed and pioneered by Surface Combustion. This record of achievement has been possible because of the company's broad background of experience in research, development, engineering, manufacturing and servicing of equipment for all heating and heat treating applications.

The result has been increased plant efficiencies and savings in time and money for leading companies in the ceramics industry.

If yours is a problem dealing with an old or new heating application, it will pay you to call a Surface Combustion engineer. The coordination of effort in planning new or expanded heating facilities will be worth your time.

SURFACE COMBUSTION CORPORATION, 2370 Dorr Street, Toledo 1, Ohio



Continuous annealing Lehr with multi-sectional construction and new high-speed, controlled cooling.

SYNTRON COMPANY

750 Lexington Ave., Homer City, Pa.

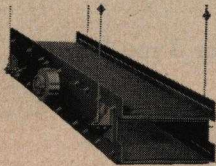
ELECTRIC BIN VIBRATORS



Pulsating Magnet Vibrators, with adjustable power, assure a positive flow of fine powders or hard-to-handle lumps, from bins and hoppers, and through chutes.

Available in a series of models from a little 4-lb. size up to a huge 950 lb. size.
Operation from 115 or 230 or 460 volts a-c.

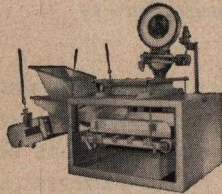
CONCENTRIC ACTION SCREENS



Mechanical, unbalanced weight type for accurate, fast medium or heavy duty sizing and separation.—From sticky ores to soft, dry feeds.—From 3" maximum lumps down to coarse grains.

Available with one, two or three decks.

WEIGH FEEDERS



For continuous feeding of bulk material at a constant weight. Predetermined setting of scale automatically maintains desired weighed flow of material per unit of time.

Available in six models with maximum capacities from 600 lbs. to 100 tons per hour.

PACKERS AND JOLTERS



For increasing net weight content of containers and to vibrate molds, forms, etc.

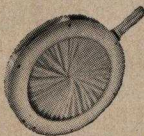
Packers are electromagnetically operated. Power can be varied to suit the material.

Jolters are operated by water or air pressure. Effectively handle light, fluffy materials.

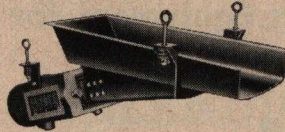
FLOW CONTROL VALVES

For the flow control and shut-off of free-flowing powdered materials or controlling eddy-free air for heating, ventilating and drying.

Flexible nylon fabric diaphragms form concentric apertures in opening or closing—no jamming or clogging.



VIBRATORY FEEDERS

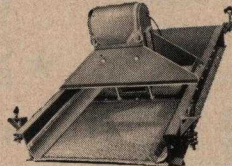


Controlled feeding of bulk materials—hot or cold—dry or damp—fine powders to big chunks—from pounds to hundreds of tons per hour.

Electromagnetic drives operate from either 115 or 230 or 460 volts a-c. No gears, cams or belts.

Available with flat pan or tubular troughs—for base or suspension mounting—and with either above or below deck driving magnets.

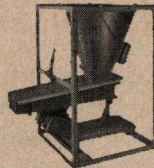
PULSATING MAGNET SCREENS



Low cost, effective screens for medium and fine dry sizing operations. Electromagnetic drive with adjustable power—no gears, belts or eccentrics.

Furnished with woven wire cloth of phosphor bronze, stainless or high tensile steel with 80 mesh to 3/4" openings. Of hook-strip type for quick installation and replacement.

DRY FEEDER MACHINES



Complete machines—made up with a vibrated, non-arching supply hopper and a "Vibra-Flow" Feeder with variable control of material flow.

For feeding small quantities (up to 10 tons per hour) of dry chemical reagents, and additives in processing operations.

TEST SIEVE SHAKERS



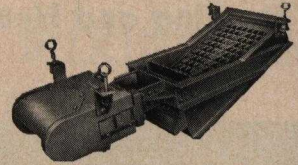
Provide quick and accurate sieve analysis. They are equipped with timer for accurate time tests—rheostat and voltmeter for uniform testing. Operate on ordinary 115 volt a-c.

HOPPER LEVEL SWITCHES

Automatically maintain desired minimum and maximum amount of material in bins or hoppers. Switches control feeder supplying hopper. Sturdy, diaphragm type switches for economical maintenance-free hopper control.



SCREENING FEEDERS

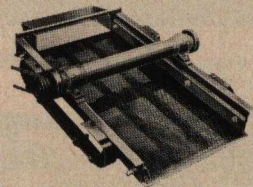


Utilize powerful, highspeed electromagnetic drives to size, dewater, desilt and desludge bulk materials.

Provide simultaneously, two basic operations—highly efficient sizing and controlled, variable feeding.

Can be furnished with wedge slot, flange lip or woven wire cloth screen surfaces.

UNBALANCED PULLEY SCREENS

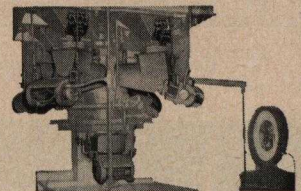


"UP" Screens for fast, accurate fine sizing. Light to medium weight dry materials—up to 1" maximum.

"NRM" Screens for efficient separation of fine particle solids from liquids—down to 120 mesh.

Available in single or multiple decks—in open or enclosed models.

BATCH WEIGH PLANTS



For accurately weighing out net batches of material. Scales automatically control fast feed, slow dribble feed and cut off of Vibratory Feeders.

A-C TO D-C POWER UNITS



Complete units—with a-c and d-c switchgear, transformers, voltage regulator and meters—designed to convert a-c to the proper d-c power supply for industrial applications.

Available in sizes from 3/4 to 500 KW.

Infra-red HEATING PANELS

Compact, box-shaped—throw an intense, flat, radiating pattern of infra-red heat. Heat by direct radiation—not by reflection. Economical for baking, heating and drying.



Representatives in Principal Cities

Atlanta - Baltimore - Birmingham - Boston - Buffalo - Chicago - Cincinnati - Cleveland - Columbus
Dallas - Des Moines - Detroit - Hartford - Houston - Indianapolis - Kansas City - Los Angeles
Milwaukee - Minneapolis - Newark - New Orleans - New York - Philadelphia - Pittsburgh - Portland
St. Louis - Salt Lake City - San Francisco - Seattle - Syracuse - Toledo - Toronto and Montreal.

Check Your Telephone Directory

SYNTRON

THE CHAS. TAYLOR SONS CO.

A SUBSIDIARY OF NATIONAL LEAD COMPANY

MANUFACTURERS OF SPECIAL REFRACTORIES

CINCINNATI 14, OHIO • PHONE WABASH 1-0250 • CABLE ADDRESS "TAYCO" CINCINNATI

SERVING THE CERAMIC INDUSTRY SINCE 1864

SALES OFFICES: Atlanta; Chicago; Cincinnati; Detroit; Haddonfield, N. J.; New York; Pittsburgh; St. Louis.

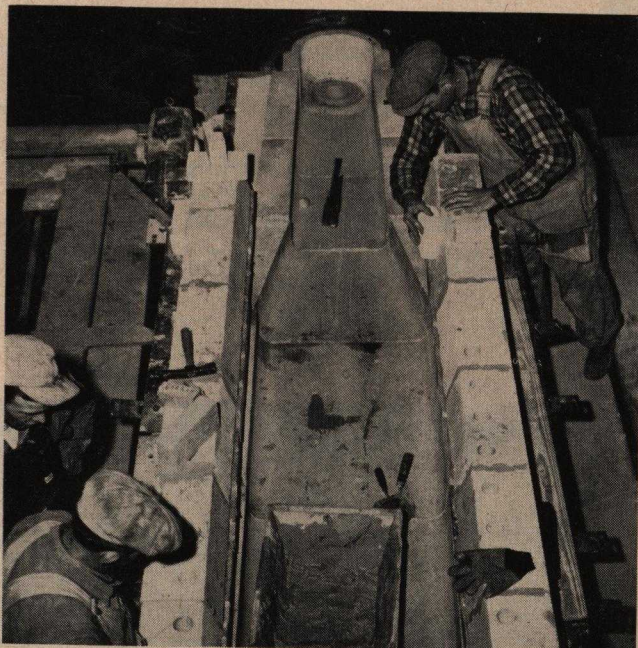
SALES AGENCIES: Houston, Texas: The Great Southern Supply Co.; Santa Fe Springs, Calif.: Pryor-Giggey Co.; Hamilton, Ont. and Montreal, P. Q., Canada: Refractories Engineering & Supplies, Ltd.; Mexico: Amerex Ingenieros, S. A., Mexico City 11, D. F.; Export: International Div., Ferro Corp., Cleveland, O.

TAYLOR SILLIMANITE (TASIL) FEEDER PARTS AND FOREHEARTH REFRACTORIES

Taylor Sillimanite (TASIL) expendable feeder parts and forehearth shapes not only last longer than the best grades of clay or silica parts but they materially improve glass quality and increase production.

1. TASIL Feeder Parts are less subject to erosion. They retain their original size and shape longer, providing closer control of both weight and shape of the glass "gob"; hence fewer shutdowns for parts replacement.
2. Less refractory is dissolved into the glass, at the spout, minimizing rejections due to inclusions of refractory in the ware.
3. TASIL refractories will not drip, and being low in iron, any glass which condenses on the working face will remain clean.

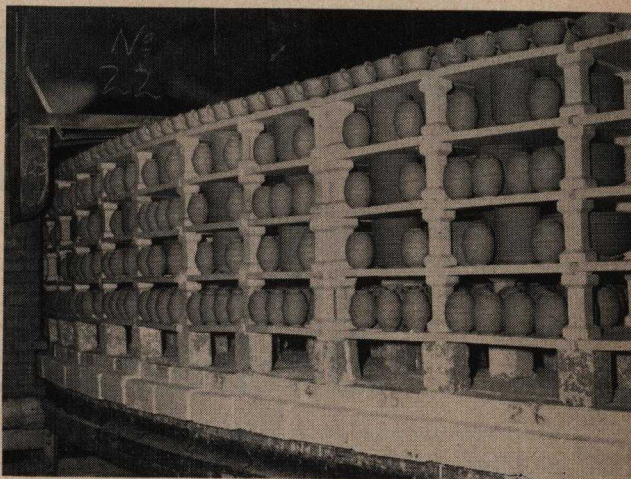
Throughout the Glass Industry, TASIL Super refractories have established new records for feeder efficiency and service life, for quality and uniformity of ware produced. Use Taylor Zircon Feeder Parts for increased production of boro-silicate and dense opal glasses. It will pay you in profits to discuss your particular feeder refractory problem with a Taylor Field Representative.



Erecting a complete TASIL "KW" Feeder. Shown are TASIL Arch Anchor Blocks, Channels and Spout. Tight, weld-like joints are obtained by bonding all shapes with TASIL No. 301 Air-Setting Cement.

TASIL KILN FURNITURE

Standard TASIL Slabs and Posts give exceptional service in continuous kilns fired to Cone 10 and above, on cycles not less than 50 hours. For example, in 1935, an Indiana pottery making chinaware completely equipped their tunnel kiln with TASIL Standard Slabs and Posts. With the exception of 100 replacements received in 1948, nearly all the 1200 original posts were still in service after 16 years. The TASIL Slabs have averaged better than two year's service each. Prove for yourself the economy of these TASIL Refractory Products.



TASIL Slabs and Posts entering Ladd Cronin Tunnel Kiln fired to Cone 10 on 72-hour cycle. Most of the posts shown have been in service 16 years.

TAYLOR ZIRCON SAGGERS AND PLATES



Taylor ZIRCON Saggars and Plates are used by the ceramic industry to support steatite and special titanium-bearing porcelains during firing. Taylor Zircon refractories are inert in either a reducing or an oxidizing atmosphere within a temperature range of 2350° to 2550° F. and are stable under conditions where silicon-carbide is subject to failure due to oxidation and permanent growth. For complete data, write for Bulletin 202-R.

TENNESSEE CORPORATION

1028 Connecticut Avenue, N. W.

Washington 6, D. C.



*

"Potassium Silicofluoride and Sodium Silicofluoride"

When you use T. C. Silicofluorides, you can depend upon receiving materials of uniform quality of the highest chemical standards and superior physical characteristics, shipped in the best containers available, and above all you can rely upon continuity of supply at stable prices.

only TAM offers a complete line of ZIRCONIUM OPACIFIERS

TAM makes a strong point of supplying a complete line of opacifiers. This offers you a selection of those best suited to your operation. You benefit from the unique advantages of those you choose by getting the results you expect. And because you can depend upon uniformity from lot to lot, your results are consistent.

Perhaps equally important is the strong staff of **TAM** researchers and production people always ready to cooperate with you—through **TAM** Ceramic engineers in the field.

This combination of quality supply and service assures your satisfaction. It's a good reason why more **TAM** opacifiers are used than any other brand.

TAM ZIRCOPAX, SUPERPAX and SUPERPAX A, known for their extreme fineness and purity, are used in glazes for all classes of ware including high fired sanitary ware and electrical porcelains. Opacity, texture control, craze resistance, and color stability in both pastels and darker colors are improved by their use.

TAM Calcium Zirconium Silicate provides a brighter, closer grained texture with high opacity when used as an opacifier for glazes. Extensively used in glazes of the high cone range firing type, it can be used for texture control of matte finishes in zinc free glazes.

TAM Magnesium Zirconium Silicate is another opacifier used with other compounds to produce more opaque whites. It has exceptional properties for controlling texture of low temperature matte glazes while introducing MgO without serious devitrification.

TAM Zinc Zirconium Silicate is unique for artware or low temperature glazes. It tends to soften and make closer grained texture. Color brilliance is good when used alone or blended with other Zirconium Silicate compounds. Opacity is moderate.

TAM Zirconium Spinel is the most universal of the synthetic Zirconium silicates. Its most unusual property is in widening the firing range of a glaze. It produces and preserves a bright finish through a wide range of firing.

TAM OPAX finds wide use in dinnerware, artware and wall tile...especially in glazes maturing above cone 3. Acting as a color stabilizer, it also promotes craze resistance.

Representatives:

Pacific Coast States:

B. F. WAGNER & COMPANY
186 North Vernon, Pasadena 3, California

Europe:

ASSOCIATED LEAD MANUFACTURERS LTD.
Zircon Division, Crescent House
Newcastle upon Tyne 1, England

Australia:

ROBERT BRYCE & COMPANY PTY. LTD.
526 Little Bourke Street, Melbourne C.L., Australia
Also Sydney, Australia, and Wellington, New Zealand

South and Central America, Mexico, Japan and South Africa:

International Division
FERRO CORP.



Executive and Sales Offices: 111 Broadway, New York City

General Offices, Works and Research Laboratories: Niagara Falls, New York

typical chemical analysis

TAM PRODUCTS	ZrO ₂	SiO ₂	TiO ₂	Fe ₂ O ₃	Al ₂ O ₃	Cr ₂ O ₃	BaO	CaO	CuO	MgO	PbO	SrO	ZnO	Bi ₂ O ₃
OPAX	89.84	6.74	0.82	0.09	0.61		0.01	0.07	0.002	0.18				
OPAX S	85.36	10.58	0.60	0.08	0.68		0.02	0.05	0.005	0.20				
TREOPAX	91.51	5.32	0.68	0.08	0.36		0.01	0.03	0.002	0.02				
ELECTRICALLY FUSED ZIRCONIUM OXIDE — Lump	98.52	0.56	0.54	0.08	0.16		0.01	0.03	0.002	0.07				
ELECTRICALLY FUSED ZIRCONIUM OXIDE — Milled	94.85	3.51	0.58	0.12	0.82		0.005	0.05	0.002	0.12				
"G" ZIRCON GRANULAR	66.32	32.23	0.28	0.04	0.79		0.005	0.03	0.001	0.01				
"G" ZIRCON MILLED	65.94	32.65	0.29	0.06	0.81		0.004	0.03	0.003	0.01				
TAM ZIRCON GRANULAR	65.64	33.94	0.04	0.03	0.23		0.001	0.03	0.001	0.01				
TAM ZIRCON MILLED	65.52	33.34	0.26	0.05	0.74		0.003	0.03	0.002	0.03				
ZIRCOPAX	64.86	34.06	0.17	0.05	0.61		0.005	0.04	0.002	0.05				
SUPERPAX	63.33	34.77	0.20	0.05	0.64		0.005	0.02	0.001	0.18				
SUPERPAX A	62.47	35.67	0.17	0.05	0.59		0.005	0.02	0.001	0.17				
MELTOPAX	53.59	25.96	0.25	0.12	0.41		0.005	0.05	0.002	0.03				
ZIRCONIUM SPINEL	39.50	20.38	0.10	0.05	20.68			0.05	0.005	0.03			19.20	
CALCIUM ZIRCONIUM SILICATE	50.62	25.94	0.26	0.12	0.76		0.01	19.21	0.001	2.64		0.02		
CALCIUM ZIRCONIUM SILICATE A	46.81	25.20	0.20	0.06	0.42		0.05	18.30	0.003	2.98		0.01		
MAGNESIUM ZIRCONIUM SILICATE	54.24	28.11	0.22	0.16	0.38		0.005	0.30	0.003	16.31				
ZINC ZIRCONIUM SILICATE	46.44	23.42	0.25	0.03	0.66		0.01	0.20	0.01	0.05			28.57	
CERAMIC RUTILE	1.52	1.08	93.32	2.67	0.59	0.12	0.005	0.03	0.001	0.15				
BARIUM TITANATE — Ticon B	0.01	0.34	33.10	0.03	0.45		63.89	0.06	0.002	0.01		0.52		
BISMUTH TITANATE — Ticon Bi	0.05	0.50	24.90	0.03	0.10					0.05				74.00
CALCIUM TITANATE — Ticon C	0.02	0.86	57.14	0.07	0.44		0.05	38.98	0.001	0.15		0.20		
LEAD TITANATE — Ticon P	0.05	0.71	25.40	0.04	0.36		0.01	0.05	0.001	0.10	73.18	0.01		
MAGNESIUM TITANATE — Ticon MC	0.06	11.84	40.54	0.09	5.22		0.04	0.10	0.005	40.56		0.01		
STRONTIUM TITANATE — Ticon S	0.01	1.24	42.95	0.03	0.46		0.50	0.25	0.001	0.05		52.26		
ZINC TITANATE — Ticon ZB	0.01	0.29	32.45	0.03	0.10		0.01	0.10	0.003	0.05	0.05		66.73	
H. G. TITANIUM OXIDE — Ticon T	0.01	0.60	98.02	0.02	0.54		0.07	0.03	0.001	0.03		0.02		
BARIUM ZIRCONATE — Ticon BZ	40.18	1.70	0.25	0.10	0.11		50.92	0.10	0.001	0.05		0.32		
CALCIUM ZIRCONATE — Ticon CZ	64.31	2.72	0.30	0.09	0.13		0.05	28.22	0.002	0.05		0.05		
LEAD ZIRCONATE — Ticon PZ	34.10	1.26	0.22	0.11	0.25		0.04		0.002	0.07	63.51	0.03		
MAGNESIUM ZIRCONATE — Ticon MZ	68.24	4.02	0.31	0.25	0.20		0.005	0.11	0.005	22.88		0.01		
STRONTIUM ZIRCONATE — Ticon SZ	51.01	3.75	0.34	0.16	0.31		0.80	0.15	0.001	0.05		40.63		
BARIUM STANNATE — Ticon BT	0.05	1.20	0.08	0.02	0.27		47.38	0.05	0.01	0.06	0.02	0.38		
MAGNESIUM STANNATE — Ticon MT	0.005	0.33	0.08	0.05	0.31		0.10	0.10	0.01	20.22	0.01	0.01		
STRONTIUM STANNATE — Ticon ST	0.06	0.66	0.05	0.01	0.19		0.35	0.05	0.01	0.05	0.02	39.01		

zirconium and titanium

TAM ceramic products

STANDARD SHIPMENT SIZE

K ₂ O	Na ₂ O	Li ₂ O	P ₂ O ₅	V ₂ O ₅	MnO ₂	SnO ₂	Ign loss	F	SO ₃	Paper Bags	Drums or Barrels	Minimum Carload	TAM PRODUCTS
0.02	0.82		0.04		0.001		0.67	0.18		80 lbs.	550 lbs.	36,000 lbs.	Opax
0.01	0.99		0.05		0.001		1.28	0.16		50 lbs.	400 lbs.	36,000 lbs.	Opax S
	0.98		0.03		0.002		0.97			80 lbs.	550 lbs.	36,000 lbs.	Treopax
	0.005				0.004						100 lbs.	36,000 lbs.	Electrically Fused Zirconium Oxide — Lump
	0.02				0.002						100 lbs.	36,000 lbs.	Electrically Fused Zirconium Oxide — Milled
	0.005		0.12		0.001		0.08			100 lbs.		50,000 lbs.	"G" Zircon Granular
	0.005		0.11		0.001		0.08			100 lbs.		50,000 lbs.	"G" Zircon Milled
	0.005		0.09		0.0005					100 lbs.	500 lbs.	36,000 lbs.	TAM Zircon Granular
	0.004		0.10		0.001		0.14			100 lbs.	550 lbs.	36,000 lbs.	TAM Zircon Milled
	0.01		0.11		0.001		0.11			80 lbs.	500 lbs.	50,000 lbs.	Zircopax
	0.005		0.09				0.70			50 lbs.	400 lbs.	50,000 lbs.	Superpax
	0.005		0.08				0.92			50 lbs.	400 lbs.	50,000 lbs.	Superpax A
0.06	13.56	0.05	0.07		0.001		5.93			80 lbs.	550 lbs.	36,000 lbs.	Meltopax
	0.03	0.01	0.06		0.002		0.09			80 lbs.	500 lbs.	36,000 lbs.	Zirconium Spinel
	0.01	0.01	0.07	0.01	0.005		0.24			80 lbs.	500 lbs.	36,000 lbs.	Calcium Zirconium Silicate
	0.02		0.07	0.01	0.002		5.10			50 lbs.	400 lbs.	36,000 lbs.	Calcium Zirconium Silicate A
0.01	0.01	0.005	0.07	0.005	0.05		0.07			80 lbs.	500 lbs.	36,000 lbs.	Magnesium Zirconium Silicate
	0.01		0.07		0.001		0.26			80 lbs.	500 lbs.	36,000 lbs.	Zinc Zirconium Silicate
0.01	0.005		0.09	0.26	0.04	0.07	0.09			100 lbs.	600 lbs.	40,000 lbs.	Ceramic Rutile
0.05	0.12	0.03	0.08	0.001	0.0005		0.73		0.40		100 lbs.	30,000 lbs.	Barium Titanate — Ticon B
			0.07								100 lbs.	30,000 lbs.	Bismuth Titanate — Ticon Bi
0.03	0.20		0.07	0.01	0.001		1.65		0.28		100 lbs.	30,000 lbs.	Calcium Titanate — Ticon C
0.02	0.01		0.10	0.01	0.005		0.26				100 lbs.	30,000 lbs.	Lead Titanate — Ticon P
0.05	0.01		0.11	0.002	0.005		1.11				100 lbs.	30,000 lbs.	Magnesium Titanate — Ticon MC
0.05	0.02		0.10	0.001	0.001		2.02		0.21		100 lbs.	30,000 lbs.	Strontium Titanate — Ticon S
0.10	0.10	0.01		0.01	0.001	0.01	0.09		0.01			30,000 lbs.	Zinc Titanate — Ticon ZB
0.02	0.005		0.41		0.0005		0.29				100 lbs.	40,000 lbs.	H.G. Titanium Oxide — Ticon T
0.05	0.11	0.01	0.04	0.001	0.0005		5.69		0.33		100 lbs.	30,000 lbs.	Barium Zirconate — Ticon BZ
	0.05	0.02	0.06	0.005	0.001		3.31		0.31		100 lbs.	30,000 lbs.	Calcium Zirconate — Ticon CZ
0.02	0.01		0.04		0.005		0.40				100 lbs.	30,000 lbs.	Lead Zirconate — Ticon PZ
	0.01		0.06	0.002	0.005		3.84				100 lbs.	30,000 lbs.	Magnesium Zirconate — Ticon MZ
		0.05	0.05	0.002	0.002		2.32		0.22		100 lbs.	30,000 lbs.	Strontium Zirconate — Ticon SZ
0.02	0.02	0.01		0.01	0.001	46.78	3.64		0.19		100 lbs.	30,000 lbs.	Barium Stannate — Ticon BT
0.02	0.01	0.01		0.01	0.002	77.92	0.92		0.01		100 lbs.	30,000 lbs.	Magnesium Stannate — Ticon MT
0.01	0.02	0.01		0.01	0.005	58.22	1.29		0.02		100 lbs.	30,000 lbs.	Strontium Stannate — Ticon ST

TAM
DIVISION NATIONAL LEAD COMPANY

Tam Trademarks

The following are trademarks of the Titanium Alloy Manufacturing Division of National Lead Company and are registered in the United States Patent Office.

TAM
ALTAM
CARBORTAM
F. C. T.
INSULOXIDE
MELTOPAX
OPAX

RUFLUX
SETIT
SUPERPAX
TICON
TREOPAX
ZIRCONITE
ZIRCOPAX

TAM ZIRCONIUM OPACIFIERS

Among many important advantages of TAM opacifiers, the five listed below are especially worth noting.

HIGHER ABRASION RESISTANCE

Findings of Taber Abrasion Apparatus tests are confirmed by production experience.

IMPROVED OPACITY

With an increase of 2 to 5% in reflectance, thinner applications of enamel are practical.

COLOR UNIFORMITY and STABILITY

In both ground and cover coats.

IMPROVED LUSTRE and FINISH

A higher gloss without scumming from over firing.

COOPERATION ON CERAMIC PROBLEMS

of all types is available through TAM Field Engineers and our well-staffed laboratory.

FOR OPTIMUM RESULTS

We recommend for:

Antimony Non A. R. frits: - Treopax or Opax S

Antimony A. R. frits: - Opax, Treopax or Opax S

Zircon frits: - Treopax or Opax S

Titanium frits: - Treopax or Opax S

C. I. Enamels: - Opax or Opax S

TAM ZIRCONIUM OXIDE

vitreous enamel mill addition opacifiers OPAX, OPAX S, and TREOPAX give economical and uniformly excellent results. The correct opacifier increases the elasticity of the enamel and reduces the chipping tendency.



Executive and Sales Offices:

111 Broadway, New York City

General Offices, Works and Research Laboratories:

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**TAM
OPAX**

**TAM
ZIRCOPAX**

**TAM
SUPERPAX**

**TAM
MELTOPAX**

**TAM
TREOPAX**

**TAM
SETIT**

**TAM
ZIRCON MILLED**

**TAM
DOUBLE SILICATES**

THAYER SCALE CORP.

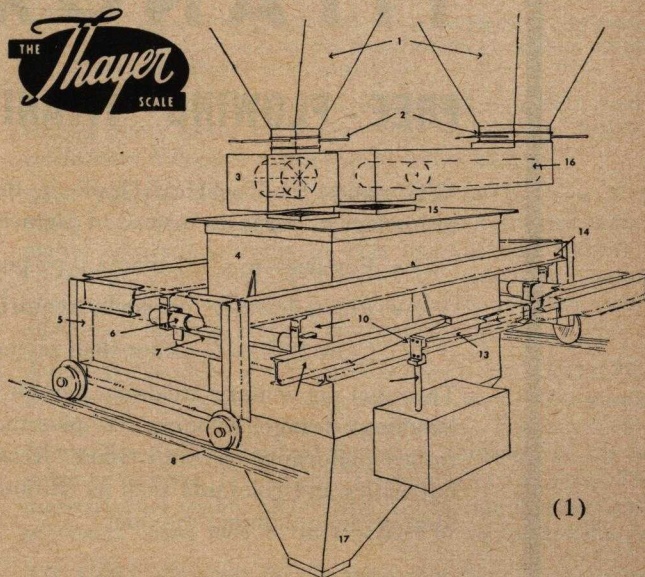
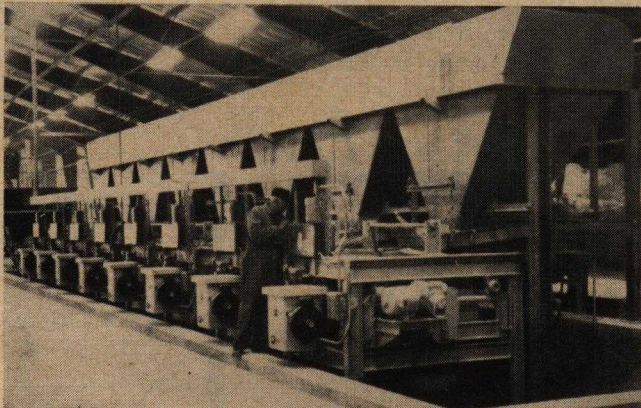
21 THAYER PARK
PEMBROKE, MASS.

BATCHING — PROCESSING — CONTINUOUS WEIGHING SYSTEMS

To answer the need of the Clay, Brick and Ceramic Industries for rapid, highly accurate material formulation, THAYER SCALE's research and engineering staff has developed completely automatic weighing systems built to meet exacting requirements.

The AUTOWEIGHTION systems, based on the exclusive Thayer Flexure Plate system of leverage, offer pinpoint accuracy in the mixing of a wide range of heretofore hard-to-handle materials. The batching of materials, such as raw clay and grogs which may vary from oozy-wet one day to rock-hard the other, is typical of the problems answered by Thayer AUTOWEIGHTION. Heavy, sticky and flushing powdery materials are handled with equal ease.

It has been Thayer's experience that each installation needs individual applications to solve formulating problems economically and efficiently as exemplified by this installation at the Valentine Division, A. P. Green Fire Brick Co.



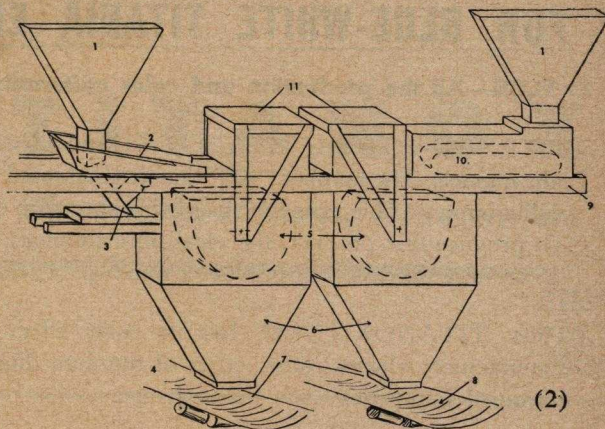
- 1 SUPPLY HOPPERS
- 2 SLIDING GATES
- 3 ROTARY FEEDER (ANTI FLUSH)
- 4 WEIGH HOPPER OR DUST CABINET
- 5 LORRY CAR
- 6 TORQUE TUBES
- 7 WEIGH FRAME
- 8 RAILS

- 9 EQUALIZER LEVERS
- 10 FLEXURE PLATES
- 11 DRAFT ROD
- 12 BEAM BOX
- 13 MAIN LEVERS
- 14 MAIN CAR FRAME
- 15 MATERIAL INLETS
- 16 "C" BELT FEEDER
- 17 MATERIAL OUTLET

The diagrams shown here pertain to two basic principles used in formulating scale systems. The weigh lorry (1) is used when many ingredients are necessary to make a single batch. Briefly, the lorry is positioned under a selected supply hopper and a specified charge of material is fed into the weigh hopper which is suspended from the scale weighing members by Thayer Flexure Plates. The amount of feed is controlled by weight which is registered in the beam box.

When the scale comes to balance, the material flow stops and the lorry is free to move to the next station or to a mixer where the batch will be discharged. Thayer lorry car systems are built to operate either manually or automatically by programming, employing punch cards or similar devices.

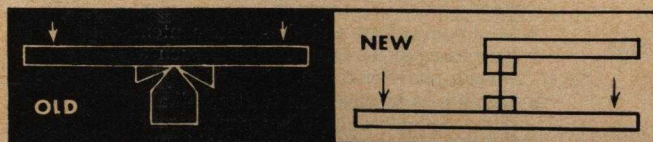
The second example (2) involves the feeding of materials to the weigh cabinets' rotary buckets from a vibratory feeder and a belt feeder. The buckets, suspended from the scales, dump when the desired weight has been reached and the batch is fed to a mixer by conveyors. These two methods of formulating are basic and adaptations are made to meet the specifications of a given operation.



- 1 SUPPLY HOPPER
- 2 VIBRATING PAN
- 3 VIBRATOR
- 4 CONVEYOR
- 5 ROTARY BUCKETS

- 6 DUST CABINET
- 7 MATERIAL OUTLETS
- 8 CONVEYOR
- 9 MAIN FRAME
- 10 "C" BELT FEEDER
- 11 SCALES

The heart of all Thayer systems is the Thayer Flexure Plate Leverage System which is guaranteed accurate for the life of the scale. There are no knife-edge pivots to wear down and neither dirt nor vibration affect its high accuracy. The Thayer system is unsurpassed for simplicity and reliability under rugged conditions.



For complete engineering information on all Thayer systems write to the above address.

TITANUM PIGMENT CORPORATION

Subsidiary of NATIONAL LEAD COMPANY

General Office—111 Broadway, New York 6, N. Y.

TITANOX[®]-TG*

FREE - FLOWING TITANIUM DIOXIDE OF HIGH PURITY

*TG stands for Technical Grade in the sense of usage for general technical or technological purposes instead of pigment purposes . . .

- For frit—to yield titania type porcelain enamels.
- For all other products requiring titanium dioxide as a CHEMICAL COMPOUND rather than pigment.

This non-pigmentary titanium dioxide presents easy working qualities—ease of handling, storage, blending . . . plus maximum titanium dioxide content and controlled uniformity of composition. Remarkable freedom from harmful amounts of impurities and colorants such as chromium is an outstanding characteristic of this ideal ceramic titanium dioxide.

TITANOX[®]-TG-400

FOR BLUE-WHITE TITANIA ENAMELS . . .

PLUS—All the production and color uniformity advantages of TITANOX-TG

TITANOX-TG-400 is TITANOX-TG modified to yield blue-white titania porcelain enamels. The number "400" denotes increased relative reflectance in the 400-500 millimicron or blue range of the visible spectrum of white titania porcelain enamels. To produce this product, the ideal pure titanium dioxide base—TITANOX-TG—is carefully processed to provide a titanium dioxide constant in bluing effect.

Thus, TITANOX-TG-400 has its color effect positively controlled during its manufacture, whereas other types of titanium dioxide depend for color effect upon entrained impurities from titanium ore.

SALIENT PROPERTIES OF TITANOX-TG and TITANOX-TG-400

Physical

- Particle size—7 to 20 microns—free from large hard aggregates.
- Free-flowing.
- Higher apparent or bulk density than pigment type.
- Specific gravity 3.9 - 4.1.
- Melting point—about 1825° C.

Chemical

- High titanium dioxide content—usually exceeds specified minimum of 99%.
- Minimum of trace elements affecting color.
- Minimum sulfate and phosphate content.
- Exclusion of harmful elements such as barium and chromium.
- Solubility—insoluble in water, alkalis, acids. Soluble only in hot concentrated sulfuric acid or hydrofluoric acid.

TITANOX is a registered trademark of National Lead Co.

ADVANTAGES OF TITANOX-TG and TITANOX-TG-400 FOR USE IN PORCELAIN ENAMELS

TITANOX-TG and TITANOX-TG-400 are manufactured expressly for porcelain enamels. Controlled for this usage, the free-flowing "granular" nature—

- speeds production
- lowers cost of frit making
- faster to handle and blend
- requires minimum warehouse space compared to other TiO_2 's
- eliminates pre-mixing and hammer milling
- disperses readily because of fineness of granules
- smelts readily and uniformly throughout the fusion mass.

Controlled uniformity of composition assures—

- high reflectance and opacity along with whiteness
- all the other well known qualities of titania enamels.

These two non-pigmentary titanium dioxides afford the frit maker an opportunity to regulate reflectance and color of white titania enamels. If maximum reflectance and opacity are of paramount interest, TITANOX-TG alone may be preferred. On the other hand, blue-whiteness may call for TITANOX-TG-400 as the sole titania. Gradations in opacity and color tone may be secured through mixtures of these two products, the proportions being determined by frit composition and, of course, the color desired. For colored titania porcelain enamels, TITANOX-TG is preferred for maximum opacity and sharp clean colors.

As TITANOX-TG and TITANOX-TG-400 are not pigments, they do not possess high opacity and tinting strength and as a result are not suitable as mill addition opacifiers. For this purpose, water dispersible anatase titanium dioxide pigment, TITANOX-A-WD, is usually preferred. In porcelain enamels for application to aluminum, TITANOX-TG is smelted into the batch to promote acid resistance, but for whiteness, brightness and opacity, the rutile pigments TITANOX-RA-10 or TITANOX-RA-NC are preferred as mill additions.

ADDITIONAL CERAMIC USES OF TITANOX-TG

GLAZES—extensive research shows that fritted glazes self-opacified by titanium compounds can be made by smelting TITANOX-TG into the properly formulated batch. Thus used, TITANOX-TG yields glazes having outstanding whiteness, brightness and opacity at economical application weights especially for wall tile.

In established crystalline or other textured glazes where titanium dioxide is added to the mill, pigments such as TITANOX-A-MO or TITANOX-RA are usually preferred although TITANOX-TG is used for textural effects.

ACID RESISTANCE—from the standpoint of workability and uniformity of composition, TITANOX-TG is especially suited to white and light colored dry process sanitary enamels for cast iron. TITANOX-TG promotes acid resistance for low-temperature glass decorative enamels. TITANOX-RA and TITANOX-RA-50 pigment type titanium dioxides provide maximum whitening, brightening and opacifying power for these enamels.

Ceramic Colors—TITANOX-TG, due to its physical and chemical uniformity, is of interest in the manufacture of ceramic colors of which titanium dioxide is a constituent.

Colored Glass—TITANOX-TG is a natural product for use in colored glass, owing its peculiar color to titanium dioxide in combination with other oxides such as cerium oxide.

Other Types of Glass—TITANOX-TG is the best type of titanium dioxide yet developed to impart high refractive index to optical glass and brilliancy to other types of glass through increased refractive index. TITANOX-TG is of interest too, for other effects derived from titanium dioxide in glass such as viscosity of the melt, acid and alkali resistance, etc.

Electrical Porcelain or "Electro-Ceramics"—TITANOX-TG is of interest for ceramic bodies based on titanate compositions having extremely high dielectric constants. The constancy of composition, workability, and control of shrinkage of the mix, promises to make TITANOX-TG valuable in this field. These properties also qualify TITANOX-TG for use in other special whiteware bodies such as thread guides in the rayon industry.

TITANOX Pigments for Ceramics—for compositions wherein titanium dioxide pigment is suspended to achieve whiteness, brightness and opacity, the following TITANOX pigments have proved their value: TITANOX-A-WD—water dispersible anatase titanium dioxide; TITANOX-A-MO—regular anatase titanium dioxide; TITANOX-RA—rutile titanium dioxide.

Our research and technical service facilities are always available for problems in the application of titanium dioxide to ceramics.

TITANOX[®]

the brightest name in ceramics



TITANIUM PIGMENT CORPORATION

Subsidiary of NATIONAL LEAD COMPANY

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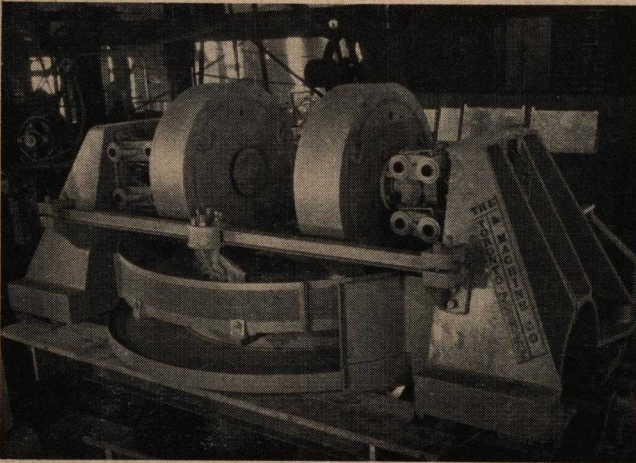
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 Portland 14, Ore., 48 S.E. Hawthorne
 San Francisco 7, Calif., 350 Townsend St.

In Canada: Canadian Titanium Pigments Limited, 630 Dorchester St., W., Montreal 2, P. Q., Canada
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THE TORONTO FOUNDRY & MACHINE CO.

Manufacturers of Clay Working Machinery
TORONTO, OHIO



New Toronto Super 60 Dry Grinders Give Up to 75 Tons of Net Production per Hour

FEATURES OF SPECIAL INTEREST

1. Knee-action mullers.

This engineering feature has been amply proven in the automotive field in both automobiles and trucks. In a grinding pan, these knee-action units give space-saving linkage of the mullers to the pan frame, thus keeping the entire interior of the pan open for introduction of material to be ground. The knee-action linkage also keeps the mullers in absolute vertical alignment for best crushing effect on the material and also offers a convenient place to apply additional pneumatic loading or suspension action to the mullers. Loading or suspension of mullers may be had as original equipment or added later as conditions warrant.

2. Underdriven arrangement.

Anyone who has changed mullers in a pan will appreciate the uncluttered open top design of these machines. A simple overhead chain block crane on rails, which we furnish as optional equipment, can be utilized to serve any part of a single pan or a battery of pans with no interference from crossbeams or superstructures. The open design also permits easy use of a lift truck for changing parts. The pinion gear runs in an oil bath, and drippings from the crown gear are caught and returned to the oil pan. The drive space under the pan is sealed and ventilated to give freedom from dust contamination for long bearing and gear life. All bearings are friction-less type with renewable cartridge units. The step bearing is a SKF-Type self-aligning bearing which requires practically no maintenance except lubrication. This pan is ideally suited for complete dust-tight enclosure around the mullers and pan frames.

3. Optional Features

Many optional features are available such as automatic pan feeding and self lubrication.

4. Additional screening area.

The pan rim is slotted and acts as additional screening area. Alloy abrasion resisting steel is used in this pan rim for long life. Since the material being ground is thrown against the pan rim by centrifugal force and then scraped away by the scrapers in the pan, one can easily see that the slotted pan rim does quite a lot of screening, thus helping to keep the pan from becoming choked. Net production from "Super '60'" B-3 dry pans and rim discharge grinders varies from 40 to 75 tons per hour depending on the material being ground.

5. Pan is reversible.

This feature is often overlooked but can mean many extra hours of service from almost all the parts in the pan.

WE OFFER ENGINEERING SERVICE AND INSTALLATION
PLANNING TO OUR CUSTOMERS

• • •

TORONTO
FOUNDRY and MACHINE CO.

Engineers, Founders and Machinists
Toronto, Ohio

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TORONTO PRODUCTS

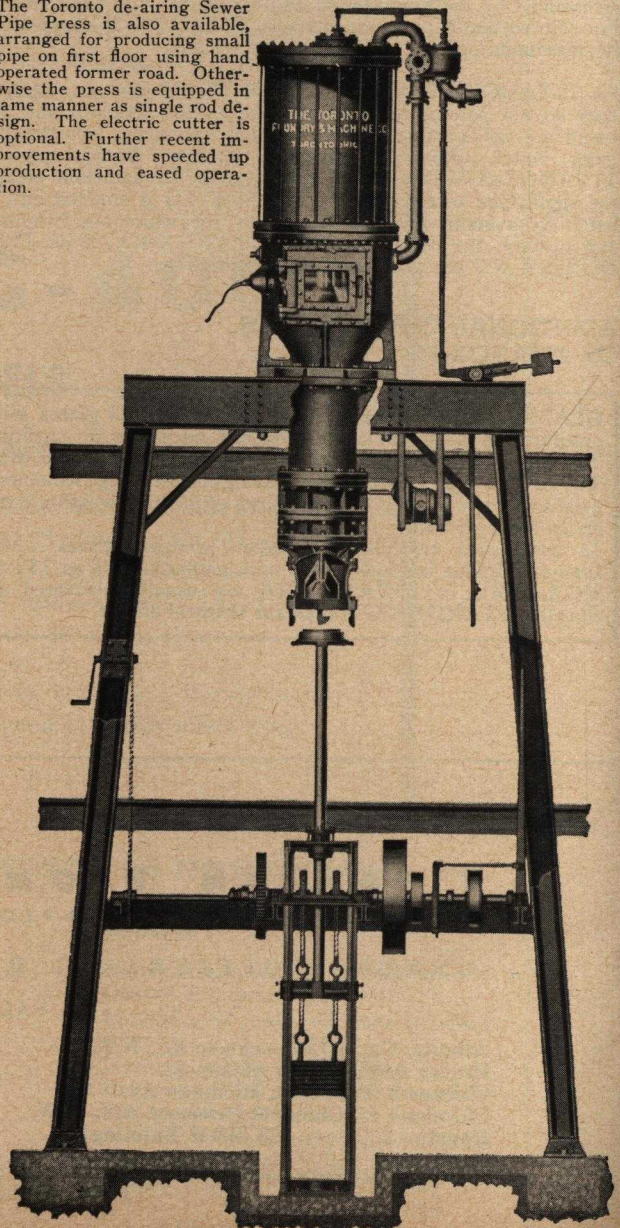
Dry grinders	Conveyors
Wet grinders (underdriven and/or overdriven)	Feeders
Combination Dry Pans	Sewer Pipe Dies
Rim discharge grinders	Special Dies
Sewer pipe presses	Laboratory and pilot plant Grinders
Wet & Dry clay elevators	Trucks, Wagons, Gigs
Gravity Cage Elevators	"Invincible" Adjustable Sewer Pipe Trucks
"Invincible" Sewer Pipe and Brick Barrows	

Toronto Steam and Hydraulic De-airing Sewer Pipe Presses Give highest flexibility of products and lowest cost of operation.

Single Rod Design—Arranged for producing large pipe of extra length on first, second or third floors. H Beam frames for production of special shapes designed to suit requirements.

Equipped with Latest valve designs, Electric Cutter with Push Button Control, Automatic Cut-off, Tell-Tale, Observation Windows and Lighting, Hand and Power Driven former rods and die hoist. Large volume de-airing chamber. A newly designed adjustable Pull-Down Cutter also available for cutting on floor.

The Toronto de-airing Sewer Pipe Press is also available, arranged for producing small pipe on first floor using hand operated former rod. Otherwise the press is equipped in same manner as single rod design. The electric cutter is optional. Further recent improvements have speeded up production and eased operation.



THE W. S. TYLER COMPANY

*Manufacturers of Woven Wire Screen, Screening Machinery,
and Testing Sieve Equipment*

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HEATED SCREENS FOR DAMP CLAY

The Ty-Electric System of electric heating of Hum-mer Screens represents the most recent development in screening damp materials.

The wire screens are heated by passing electric current through the wires. Heat keeps the surface of the wire dry so that fine damp particles will not stick and build up on the wires, blinding the openings. Send us details of your damp screening problems so our Engineering Department can make recommendations.

HUM-MER SCREEN FOR GRAIN SIZE PROPORTIONING

In tonnage capacity and accuracy of separation the Hum-mer far exceeds all other types. The demand for greater density and better quality products has made necessary positive control of grain sizes. Multiple deck Hum-mers are proving highly successful for this work. Write for Catalog 63.

TY-ROCKET CIRCLE-THROW SCREENS FOR CLAY SLIP

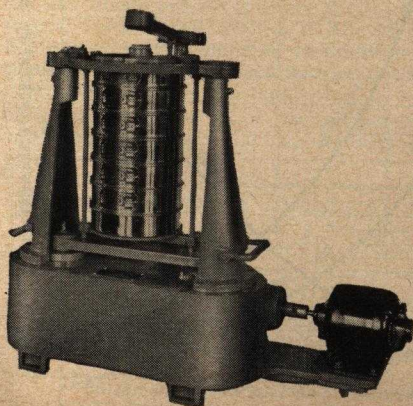
Ty-Rocket high-speed circle-throw action screens slip up to 70% solids. For clay slips and fibrous solutions the circle-throw action of the Ty-Rocket Screen is the most efficient.

WOVEN WIRE SCREENS

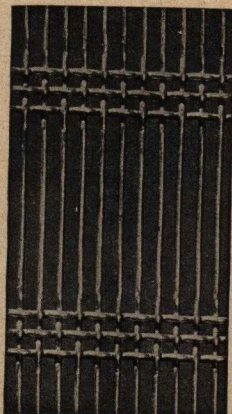
In all meshes and metals and for all purposes. High capacity weaves such as Ty-Rod and Ton-Cap greatly increase the output and lower the production costs. Special alloys offer high resistance to abrasion or corrosion. Write for Catalogue 80.

TYLER STANDARD SCREEN SCALE TESTING SIEVES AND RO-TAP TESTING SIEVE SHAKERS

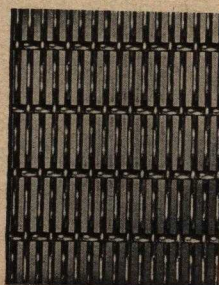
The Tyler Standard Screen Scale Testing Sieves with openings in the fixed ratio of the square root of 2 are recognized as a standard for comparison throughout the world. The Ro-Tap Testing Sieve Shaker reduces the cost and at the same time eliminates errors in making sieve tests. Write for Catalogue 53, "The Profitable Use of Testing Sieves."



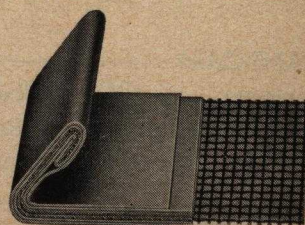
Ro-Tap Testing Sieve Shaker



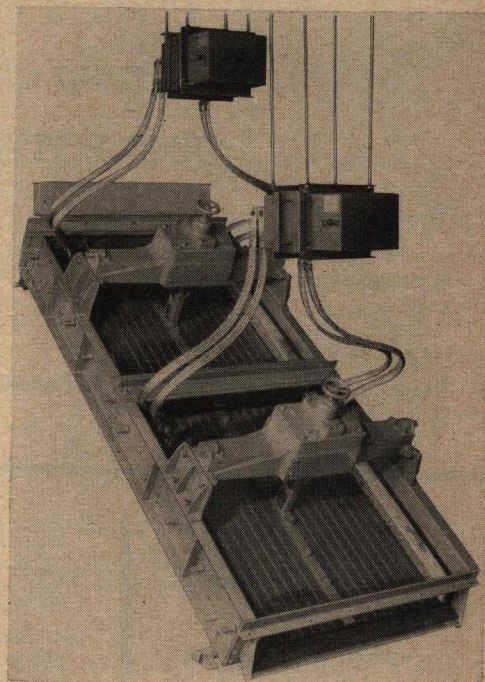
No. 9895 Ty-Rod



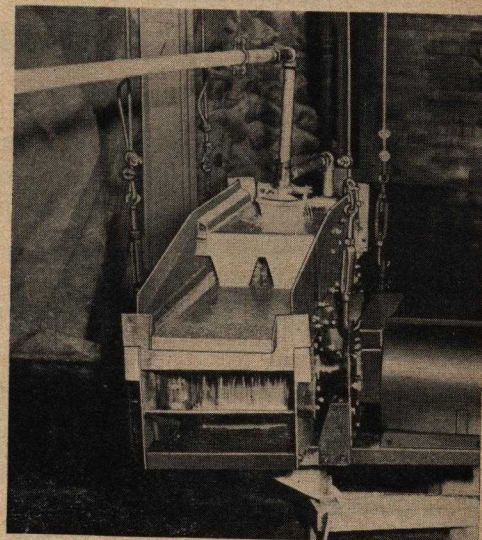
No. 819 Ton-Cap



Tyler Hook Strip for Screen Sections



4' x 10' Type 38 Tandem Hum-mer Screen heated by the Ty-Electric System.



18' x 6' Ty-Rocket Screening Slip 65% solids.

UNITED STATES GYPSUM COMPANY

Industrial Sales

300 West Adams Street, Chicago, Illinois

MATERIALS FOR CERAMIC TOOLING

Plasters • Gypsum Cements • Resins

A Complete Group of Tooling Materials for the Mold Shop

USG* POTTERY PLASTERS (3 BASIC GRADES)

#1 POTTERY PLASTER

The standard for the industry, #1 Pottery Plaster, has been proven for performance, uniformity and long life. It is the material for general shop usage.

REGULAR POTTERY PLASTER

USG Regular Pottery Plaster has been the standby for those users preferring a softer, more absorbent material.

PURITAN* POTTERY PLASTER

The hardest and most wear-resistant plaster made for molds, PURITAN Pottery Plaster was designed for the rigorous and severe conditions of mechanical clay forming machinery. It is colored green to minimize eye fatigue.

FOR BEST RESULTS

WITH USG POTTERY
PLASTERS & ULTRACAL-
HYDROCAL, FOLLOW
THESE 8 BASIC RULES

1. Store plaster in a warm and dry place, and always use the oldest plaster first.
2. Make molds as dense as possible for the job, and maintain uniform density by accurately weighing both water and plaster.
3. Use an alarm type interval timer to measure the length of soaking and mixing.
4. Use water that is fit to drink—water always at the same temperature.
5. Mix in properly designed bucket with a high-speed mechanical mixer—keep buckets and mixing equipment clean at all times.
6. Be sure to dry molds thoroughly before using them.
7. Prevent carelessness and unnecessary abuse in mold handling and use.
8. Follow mold performance in the clay-shop carefully, and at regular intervals.

HYDROCAL*-ULTRACAL* GYPSUM CEMENTS

ULTRACAL 30

This newest member of the USG HYDROCAL family is made by a catalytic process, giving this material the greatest degree of hardness, accuracy and freedom from efflorescence available in any close tolerance gypsum cement. Colored green to ease eye fatigue. Case molds of glass-like surfaces are possible.

HYDRO-STONE*

This gypsum cement is used to produce the most durable casts, since it is the hardest and strongest of all the HYDROCALs.

HYDROCAL B-11

The standard case mold material for many years, HYDROCAL B-11 embodies a high degree of accuracy, hardness and strength to produce case molds of superior smoothness and life. Excellent for working in a plastic stage.

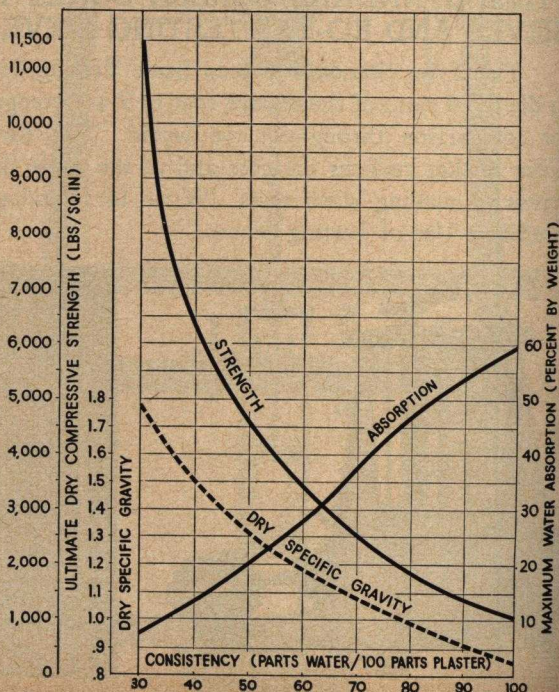
CERAMI-CAL*

This gypsum cement product was designed specifically to fulfill the rigid requirements of the Ram Process. It provides maximum die life under the most severe conditions.

Literature available on specific products.

*T.M. Reg. U.S. Pat. Off.

STRENGTH AND ABSORPTION VARIATION WITH WATER-PLASTER RATIO



EPOXICAL* PLASTIC CASE MOLD MATERIAL

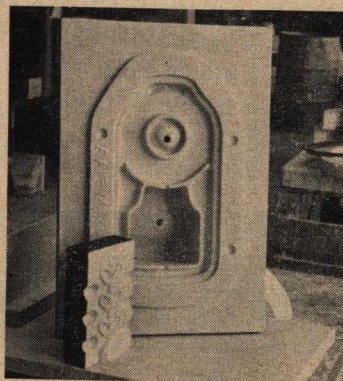
RESINS:

Surface Coat and Laminating Resins
Casting and Die Surface Resins
Heat Resistant Resin

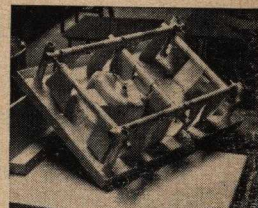
ACCESSORIES

Sealer-Separator
Reinforcing Glass Cloth and Tape

Send for Literature: IGL #400, 401, 402, 404, 405



LEFT: A finished EPOXICAL case mold for sanitaryware core. A small cup handle case mold is in the foreground.



ABOVE: A high degree of rigidity can be obtained with a light aluminum tubing frame backing an EPOXICAL lamination.

GLASS BEDDING PLASTERS

USG PLATE GLASS PLASTERS

Plasters for holding plate glass during the grinding and polishing operation are available in either unformulated plaster or in formulated form, partially or completely ready to use. Formulations are determined by consultation between customer and USG's experienced technical staff and after thorough familiarization of customer's process and individual needs. Partially formulated plasters are designed where customer wishes to have ultimate control of setting time at point of use without going to the trouble of adding all the necessary ingredients. Formulations contain setting, expansion and bonding control additives.

Important characteristics of uniformity, freedom from grit, accurate control of set, fineness and water-plaster ratios are carefully controlled in USG's modern mills. Savings can be effected where the less critical demands for first side or rough side plaster can be met from closer USG sources. The more highly refined plasters are needed for second or smooth side polishing.

Of prime importance to assure uninterrupted operation are USG's alternate and multiple sources for both bulk and bag shipments, located in areas where advantageous freight rates are available.

SPECIALIZED POLISHING PLASTERS

The demands for precision polishing of specialty optical mirror and aircraft glass can be met by special formulations, made to customer's specifications.

OPTICAL HYDROCAL

A gypsum cement formulated to give uniform density throughout thick blocks with the least possible dimensional change. Optical HYDROCAL is designed for easy removal after the polishing operation.

HINTS ON STORAGE AND HANDLING OF PLATE GLASS PLASTER

1. Store plaster in dry area.
2. Keep on pallets or platform away from concrete walls and floors to prevent condensation on bags.
3. Use oldest plaster first.
4. Reduce possibility of grit contamination:
 - a) By isolation of storage from sand and other gritty material.
 - b) By not salvaging material from broken bags on floor of warehouse or in cars.
 - c) By opening bulk cars with great care and warning unloading crew of possibility of contamination from clothing and wind.

BODY, GLAZE, AND BATCH MATERIALS

GLASS BATCH GYPSUM

Glass Batch Gypsum is carefully selected and sized raw gypsum (dihydrate $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) proven as a batch material to provide oxidizing and fining agents, as well as aiding in scum removal. Gypsum has the unusual characteristic of decomposing before melting, thereby protecting valuable refractories at the metal line from the effects of floating corrosive materials. In addition, early chemical breakdown places the products of decomposition in the proper part of the tank for most efficient fining and oxidation.

Gypsum in other forms, sizing and purity, where end use so indicates is available—such as the hemi-hydrate ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$) or anhydrous gypsum (CaSO_4).

THEORETICAL CHEMICAL ANALYSIS:

($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ Di-hydrate)	Available (O).....	27.9%
CaO.....	Available SO_2	37.2%
SO_3	Available H_2 (from H_2O)..	2.3%
H_2O	Theoretical Loss.....	67.5%

Screen Analysis: 100% thru 20 Mesh Screen
25% Maximum thru 100 Mesh Screen

LIME—DOLOMITIC

Dolomitic limes, quick and hydrated, are available from the high-purity Northwest Ohio deposits in various glass makers grades.

LIME—HIGH CALCIUM

High-calcium quick and hydrated limes are available in the Southwest from an exceptionally pure deposit located at New Braunfels, Texas.

AA-DOLOMITE

AA-Dolomite, a ceramic flux, with a proven history in pottery manufacture, is finding a wide variety of uses both in bodies and glazes in the white-ware field. An extensive and uniform deposit is located in Connecticut.

TYPICAL CHEMICAL ANALYSIS

Calcium Carbonate.....	54.45
Magnesium Carbonate.....	40.65
Tremolite ($\text{CaO} \cdot 3\text{MgO} \cdot 4\text{SiO}_2$).....	4.60
Alumina.....	.20
Ferric Oxide.....	.10
Screen Analysis: 99% min. thru 325 Mesh Screen	

Literature available on specific products.

*T.M. Reg. U.S. Pat. Off.

UNITED STATES BORAX & CHEMICAL CORP.

PACIFIC COAST BORAX COMPANY DIVISION

50 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

630 SHATTO PLACE, LOS ANGELES 5, CALIF.

DISTRICT OFFICES: 3456 Peterson Avenue, Chicago 45, Ill.
33rd and Arch Street, Philadelphia 4, Pa.
5012 Euclid Avenue, Cleveland 3, Ohio
4150 Laclede Avenue, St. Louis, Mo.
1145 Peachtree St., N. W., Atlanta, Ga.



Suppliers of BORATES AND BORON COMPOUNDS for the CERAMIC INDUSTRY

Providing a wide selection of satisfactory sources for vital B_2O_3 has been our specialty since the "20 Mule Team" days of half a century back. You are invited to avail yourself of our specialized knowledge and facilities . . . from mine to refinery . . . from laboratory and research to technically trained sales staff. The Pacific

Coast Borax Company wants to be of assistance in helping you to determine how B_2O_3 can best serve your needs. The following groups of borates, concentrates, and ores provide boron trioxide in varying degrees. Here is sodium borate in diversity to satisfy the needs of enamellers, or frit, glaze and glass makers.

Refined Boron Compounds of High Purity

BORAX	$Na_2B_4O_7 \cdot 10H_2O$
BORAX 5 MOL	$Na_2B_4O_7 \cdot 5H_2O$
ANHYDROUS BORAX	$Na_2B_4O_7$
BORAX GLASS	$Na_2B_4O_7$
BORIC ACID	H_3BO_3
BORON TRIOXIDE	B_2O_3

Economical Borates of Lesser Purity

RASORITE®46

. . . a sodium borate concentrate containing approximately 65% $Na_2B_4O_7$, 8% shale, 25% H_2O .

RASORITE®65

. . . a dehydrated sodium borate concentrate with approximately 95.35% $Na_2B_4O_7$, 9% shale, trace of H_2O .

- These two products offer economical sources of sodium borate and find ready application in ground coat and colored frits, glazes, and glasses where the small amounts of impurities do not interfere.

A Borate Ore for Special Applications

COLEMANITE (Calcium Borate)

- This ore is for uses where a relatively insoluble form of borate ($Ca_2B_6O_{11} \cdot 5H_2O$) is required.

THEORETICAL COMPOSITION

	$Na_2O\%$	$B_2O_3\%$	$H_2O\%$
BORAX.....	16.3	36.5	47.2
BORAX 5 MOL.	21.3	47.8	30.9
BORON			
TRIOXIDE	—	100	—
BORAX GLASS.....	30.8	69.2	—
ANHYDROUS			
BORAX	30.8	69.2	—
BORIC ACID	—	56.3	43.7

TYPICAL ANALYSIS

	RASORITE®46	RASORITE®65
	%	%
Boron Trioxide (B_2O_3)	47.45	65.98
Sodium Oxide (Na_2O)	21.40	28.87
Water (H_2O)	30.73	0.59
Silica (SiO_2)	1.78	1.84
Iron Oxide (Fe_2O_3)	0.13	0.07
Alumina (Al_2O_3)	0.47	0.74
Calcium Oxide (CaO)	0.65	0.76
Magnesium Oxide (MgO) ..	0.37	0.38
Sulphate (SO_3)	0.10	0.130
Carbon Dioxide (CO_2)	0.20	0.042
Equivalent Anhydrous		
Borax ($Na_2B_4O_7$)	68.57	95.35

Advantages in the use of Boron Trioxide in ENAMEL, GLAZE, AND GLASS TECHNOLOGY

DECREASES VISCOSITY
MELTING TIME AND
TEMPERATURE
DEVITRIFICATION

IMPROVES TENSILE STRENGTH
ELASTICITY
HARDNESS
APPEARANCE

LOWERS COEFFICIENT OF
EXPANSION

Samples, Bulletins, Information and Price Quotations sent on request

U. S. STONWARE COMPANY

Akron 9, Ohio

PROCESS EQUIPMENT DIVISION

BALL MILLS • JAR MILLS • MILL JARS • BURUNDUM GRINDING MEDIUM

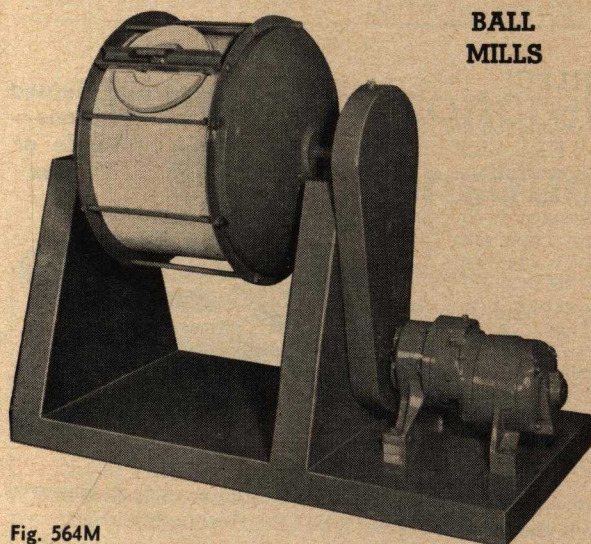
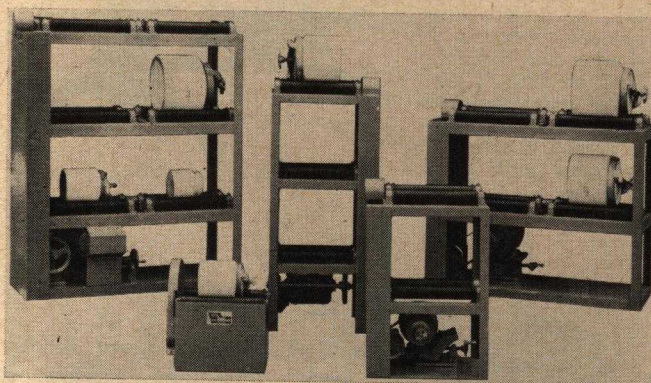


Fig. 564M

Fig. 564 M Ball Mills come equipped with solid porcelain grinding jars. The units are made in seven sizes: 12, 27, 52, 87, 117, 158 and 210 gallon capacities. The 12, 27, and 52 gal. sizes have a one-piece grinding drum encased in dome shaped steel heads (as illustrated.) In the other sizes the heavy porcelain grinding drums are made in three pieces, ground and lapped to form an airtight fit and are completely enclosed in a flanged steel casing. Frames are heavy welded steel. Drum is precision aligned and rotates in heavy duty bearings.

We likewise manufacture ball and pebble mills with steel grinding drums. They are available with the grinding drum unlined, or lined with rubber, buhrstone or high alumina ceramic. Capacities up to 600 gallons.

"U.S." UNITIZED SPACE-SAVING JAR MILLS



The Unitized line of "Roller-Type" jar mills is designed to occupy less space in busy, crowded laboratories. "Unitized" mills are fully portable, yet heavy enough to stay put. They are sturdily built with welded steel frames. Extra powerful roller chain drives and over-size Oilite bearings offer smoother running and longer

life. The mills are equipped with patented "no-creep" Neoprene oil and solvent-resistant rubber rollers, (one roll is convex, the other concave) which automatically center the jar or container. To operate the mill, the operator merely places the jar on the rollers. No clamping or fastening into frames is required.

Mills are available to handle one to twenty-four jars. Will handle any round container from 2½" to 13" in diameter. Single or multi-tier construction. Constant or variable speed drives.

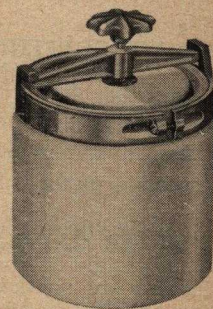
In addition to the "Unitized" line of jar mills featuring the patented "self-centering" rollers, we also manufacture a complete line of "long roll" heavy duty jar mills. Units are available with either two or three parallel rolls, with roll lengths of: 16", 24", 30", 36", 48", 66" & 72". Long roll mills are manufactured in single, double or triple tier styles, with or without cabinets.

ROALOX Burundum-Fortified MILL JARS

These jars incorporate a new body consisting of a special-high wear-resistant porcelain body related to Burundum — the high specific gravity grinding medium — in physical and chemical properties.

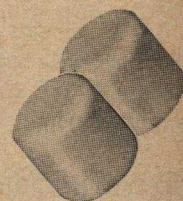
The new body adds twice to three times the wear-life to mill jars over conventional jars, with less than half the contamination factor. In addition, the mechanical strength of the jars is 2 to 1 over porcelain. Wide mouths facilitate loading and emptying. The lid, locking bar and locking hand wheel are an integral unit which makes lid removal and replacement a clean, simple operation. Oil and solvent-resistant Neoprene gaskets are standard.

Sizes—½ pint through 6.6 gallon capacity. Armored Mill Jars in the one gallon size are also available with Burundum-Fortified Mill jars.



BURUNDUM-GRINDING MEDIUM

Heavy, hard, long-wearing, Burundum cylindrical grinding medium gives maximum production with minimum contamination. Burundum is made of an especially formulated, high-fired ceramic body. It has the highest specific gravity of any non-metallic grinding medium on the market. Its chip resistance is high. Burundum grinds faster and finer. Its exclusive cylindrical shape and high specific gravity provide a substantially greater "packing density", resulting in a greater weight in a given volume, and consequently greater grinding efficiency.



Bulletin 280 describes the complete line of U. S. Stoneware Grinding and Mixing Equipment. It is free, on request.

UNIVERSAL VIBRATING SCREEN COMPANY

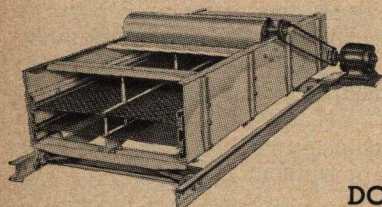
Decme Blvd. & St. Paul R. R., Racine, Wis.

UNIVERSAL VIBRATING SCREENS

Complete Line of Vibrating Screens and Small Vibratory Riddles

RUGGED, DEPENDABLE VIBRATING SCREENS FOR FAST, ACCURATE SEPARATIONS ON DRY, DAMP, WET OR STICKY MATERIALS

- WRITE FOR FREE CATALOG #150 on SCREENS and SCREENING!



Type "MR"
42" x 96"
HEAVY DUTY —
DOUBLE DECK SCREEN

HIGHER SCREENING EFFICIENCY

Powerful, fast vibratory action, distributed uniformly over every inch of the screening area, is the reason Universal is tops on difficult material. Two-point spring suspension provides its great resiliency.

GREATER CAPACITY

There are no dead areas on a Universal. The maximum screen area is employed to provide the greatest capacity per square foot of screen area. Coarse and fine separations handled simultaneously with equal efficiency.

SIMPLICITY OF CONSTRUCTION

Two-bearing design with only six points of lubrication on entire machine; no frictional surfaces, such as ratchets, cams or complicated electrical devices. Pressed steel, riveted construction throughout has made Universal famous for its durability.

LOW POWER REQUIREMENTS

In Universals the power is directed to separating the material, not wasted in shaking a heavy mass of steel. 1½ HP and single-groove drive is ample for the largest standard model.

SMOOTH, QUIET PERFORMANCE

No shaking of the building or support members with Universals. These machines operate with a steady, quiet hum under the heaviest feeds.

FAST CLOTH CHANGES

Standard widths in flat cloth-sections are mounted in convenient angle sets, for fast, inexpensive mesh applications. It takes only a few minutes to replace a worn section.

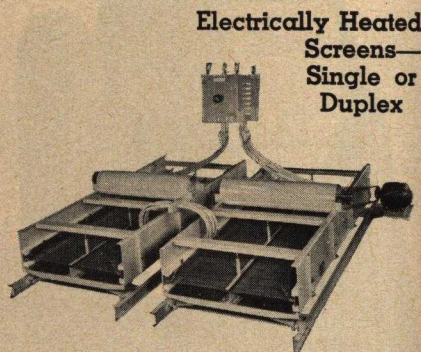
"UNILEC"

The combination of UNIVERSAL'S most powerful and evenly distributed, high-frequency vibratory action, plus UNILEC Heating, solves the most difficult separating problems. Every User of UNILEC has been more than pleased with results and repeat orders are constantly being received.

Larger capacities and much finer separations, leads to improved products and increased sales. UNILEC Heating Equipment pays for itself in a comparatively short time.

UNILEC provides the most simple method of applying electrical energy to heating the screen mesh and the cost of this equipment is surprisingly low.

Be sure to get the facts before committing yourselves on heating equipment. Now two (2) Screens can be heated most efficiently from one transformer, making the cost still lower.

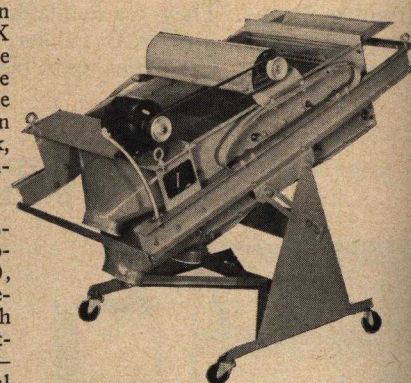


Electrically Heated
Screens—
Single or
Duplex

"UNIFLEX"

Remarkable capacities are being obtained on these UNIFLEX Models which have screen panels 24" wide and 36" long. These Units are offered in single or double deck, open or enclosed construction.

May be aerially suspended (eye-bolts provided at four corners), floor mounted if preferred or supplied with pitch-adjusting, portable stand, as shown,—operating with equal efficiency.



"UNIVIBE"

The UNIVIBE Vibratory Riddle, for batch screening, preparation of samples and testing purposes. Weighs but 39 lbs., stand and chute 15 lbs. Screen panels are quickly and easily changed. Operates from any light socket. Ask for Catalog No. 150.



UNIVERSAL ATLAS CEMENT

Division

United States  Steel Corporation

100 PARK AVENUE, NEW YORK 17, N. Y. • 208 SOUTH LASALLE STREET, CHICAGO 4, ILLINOIS
ALBANY • BIRMINGHAM • BOSTON • DAYTON • KANSAS CITY • MILWAUKEE • MINNEAPOLIS • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WACO

Refractory concrete cuts costs, saves time in kiln construction and maintenance

TYPICAL USES	Refractory	Heat-Resistant	Insulating
TUNNEL KILNS			
Car Tops	X		
Setting Floor Block (Circular)	X		
Flat Arches in Charging and Cooling Zone	X		
Side Walls in Charging and Cooling Zone	X		
Burner Block	X		
Side Benches or Hearths	X		
Flat Arch Roofs (Circular)	X		
PERIODIC KILNS			
Main and Auxiliary Flues	X	X	
Waste-Heat Flues	X		
Firebox Arches	X		
Door Arches	X		
Firebox Side Walls in Oil- and Gas-Fired Kilns	X		
Crown Insulation			X
Rectangular Kiln Crown	X		X
Seal Coat		X	
Side-Wall Patching	X		
Porthole Covers	X		
Precast Block	X		
Kiln Subfloors		X	
SCOPE KILNS			
Precast Block for Building Up End Walls	X		

Refractory concrete, made with LUMNITE* cement and suitable aggregates, can be used in numerous installations in ceramic plants — from car tops to kiln crowns, from flues to firebox arches. (See typical uses listed in the table at left.)

Used as a binder for certain types of aggregates, LUMNITE cement will produce refractory, heat-resistant or insulating concretes. Mixing, placing, forming and finishing procedures are similar to those used in making structural concrete. Refractory concrete can be cast in place or precast into special shapes and stored for future use. Highly skilled labor is not necessary. Monolithic construction eliminates troublesome mortar joints and the need for cutting and fitting brick — a costly and time-consuming operation. Because of its rapid-hardening properties, refractory concrete can be placed in service within 24 hours after mixing.

AGGREGATE SIZE

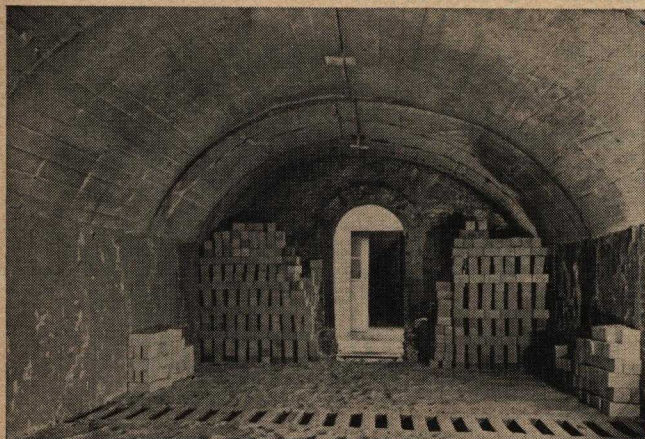
Aggregates should conform closely in size or grading to aggregates used in structural concrete, but they should carry a higher percentage of dust finer than 100 mesh. When accurate sizing is impractical, an ordinary "fly screen" may be used; 50% of the total aggregate should pass through the screen. For best results, a uniform gradation is necessary, requiring intermediate sizes between the fine and coarse particles. When aggregates are classified as fine and coarse, they should be mixed in approximately equal volumes to yield a mixed aggregate of the desired gradation. The aggregate quantity specified in a concrete mix is then made up from the two blended sizes. Table at left gives typical gradations for three different maximum particle size aggregates.

TYPICAL GRADATIONS

SIEVE SIZE	PERCENTAGE RETAINED					
	¾" to Dust		1" to Dust		1½" to Dust	
	Each size	Cumulative	Each size	Cumulative	Each size	Cumulative
1½"					0.0	0.0
1"			0.0	0.0	10.9	10.9
¾"			9.4	9.4	8.8	19.7
½"			10.1	19.5	8.1	27.8
¾"	0.0	0.0	7.3	26.8	6.5	34.3
4	17.2	17.2	11.2	38.0	6.9	41.2
8	13.1	30.3	11.9	49.9	8.8	50.0
14	19.7	50.0	9.8	59.7	9.7	59.7
28	15.0	65.0	9.2	68.9	9.1	68.8
48	11.2	76.2	7.6	76.5	7.9	76.7
100	9.5	85.7	8.4	84.9	7.8	84.5
Pan	14.3		15.1		15.5	

*"LUMNITE" is the registered trademark of the calcium-aluminate cement manufactured by Universal Atlas Cement.

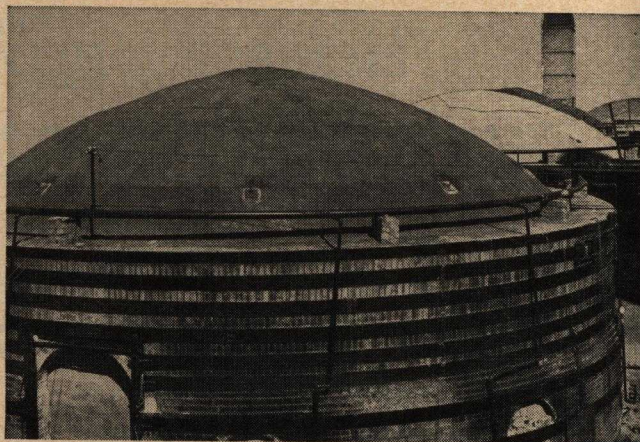
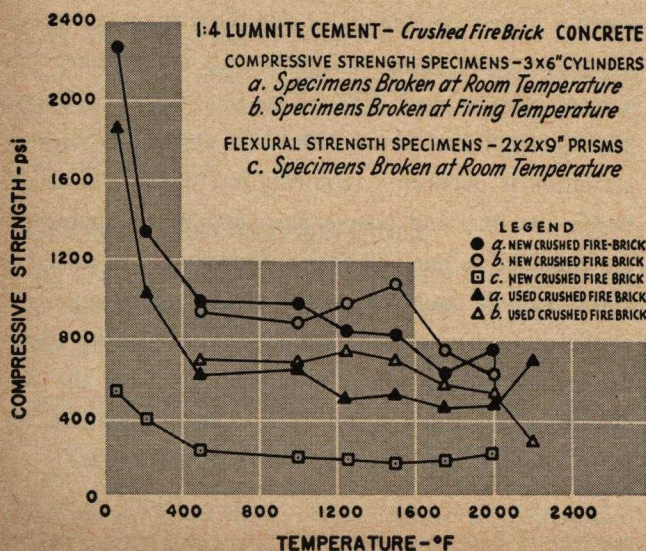
Typical refractory concrete applications



KILN CROWNS: In rectangular kiln crown construction or repairs, refractory concrete (made with LUMNITE cement and suitable aggregates) provides economical construction, low maintenance — results in more efficient kiln operation. Built easily and quickly, monolithic refractory concrete eliminates numerous joints, thus reducing heat loss and costly repairs. The only joints in the 14' x 37' roof arch illustrated here are two transverse construction joints at the third points and one lengthwise at the crown.



COMPRESSIVE AND FLEXURAL STRENGTHS



KILN CROWN INSULATION: The operating efficiency of any kiln can be increased by covering the crown with a blanket layer of insulating refractory concrete (made with LUMNITE cement and suitable aggregate). It will provide insulation and cut heat loss. Results: fuel saved, uniform burns throughout the kiln, especially on bottom courses. Seal coats also help prevent water penetration; guard against destructive effects of weather.

KILN CROWN INSULATION EASY TO APPLY

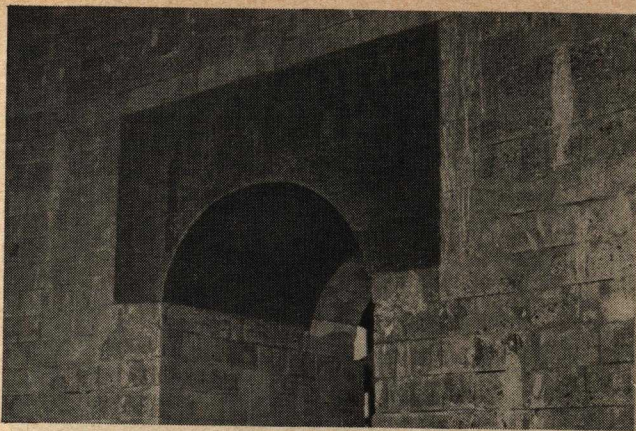
1. A neat grout of LUMNITE calcium-aluminate cement and water is washed over kiln crown.
2. A mix of 1 LUMNITE to 4 vermiculite by volume is placed 2" thick.
3. After several firings, a grout of 1 LUMNITE to 2 sand by volume is applied over crown insulation to provide a seal coat for maximum durability.



Close-up shows even texture of jointless insulating concrete on kiln crown before adding seal coat.

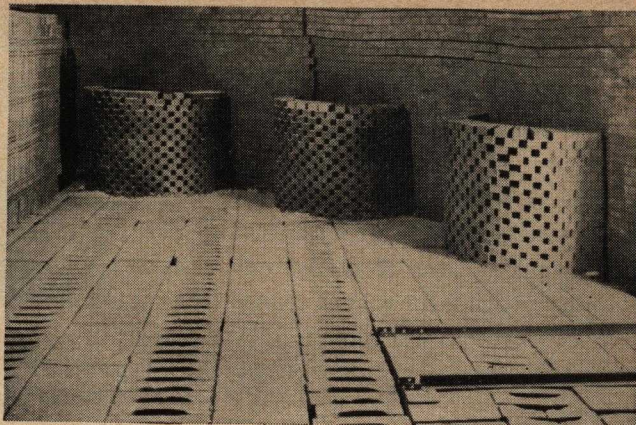
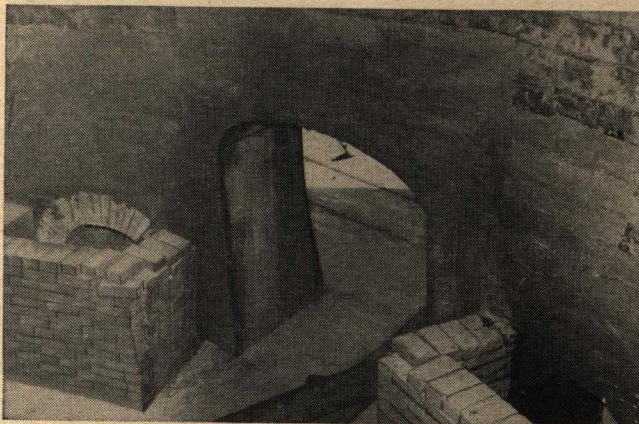
MIXING PROPORTIONS

Service Temp. — °F.	Mix by Volume	Suitable Aggregates
1800° or below	1:3 or 1:4	Second-quality crushed fireclay brick Crushed insulating fireclay brick
1800° — 2100°	1:4	First-quality or high-heat-duty crushed fireclay brick
2100° — 2400°	1:5	Crushed pottery saggers (non-talc)
2400° — 2600°	1:6	Super-duty fireclay brick Calcined flint fireclay

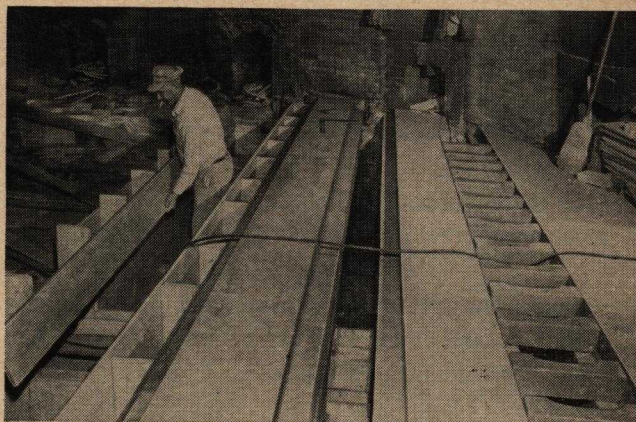


DOOR AND FIREBOX ARCHES: Monolithic refractory concrete firebox and door arches eliminate a frequent problem in ceramic plants — repairing sagging arches due to the destructive effects of heating-cooling cycles.

Refractory concrete arches can be placed easily and quickly with plant labor. They can be cast in place or precast in any shape or size. For mix design and aggregate selection, see chart on preceding page.



KILN FLUES: Complete kiln flue systems can be constructed with refractory concrete, made with LUMNITE and suitable aggregate. Refractory concrete has low volume change, gives greater stability to kiln walls and flues. Costs less than conventional construction because labor costs are lower, forms can be re-used, and standard concrete construction methods and procedures can be employed. Photo below shows flue walls after some of the concrete has been cast, forms stripped.

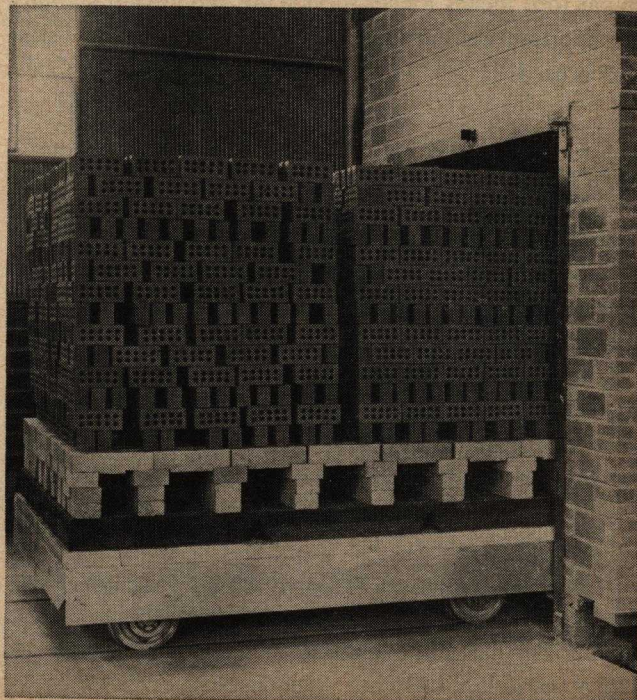


Tunnel kiln car top construction

Tunnel kiln car tops, made with LUMNITE cement and suitable aggregates, have low volume change at kiln temperatures and are highly resistant to thermal shock. This means fewer wrecks, less jamming. Spalling and cracking are minimized. Closer clearance is possible between refractory concrete car tops and kiln sides. Reduction in wrecks means higher kiln output. Refractory concrete car tops last longer — require minimum maintenance.

Cast in Place or Precast: Refractory concrete car tops can be cast in place or precast and stored for future use. The cast-in-place procedure assures an even bearing surface under all the concrete and eliminates the possibility of structural cracking from beam loading. The use of cast-in-place sections usually results in the use of larger masses of concrete in one section, so there is less danger of sections being displaced or tilted during loading or unloading operations.

Precast car tops, however, facilitate repair work where only a portion of the top needs replacing. Precast construction reduces outage, because the car can be placed in service immediately after the top blocks are in place.



car top construction (cont'd)

Typical Car Top Forming: Prior to placing the car tops, refractory insulating concrete 2" to 4" thick is placed in the pan. A 1:4 mix by volume of LUMNITE and concrete size vermiculite aggregate is satisfactory for this purpose. The insulating layer is placed monolithically, and no allowance is made for volume change. The car top should then be placed to a minimum thickness of 6". Tops of greater thickness are recommended and will give better service.

Light-gauge steel plates can be used as separators and should be well greased to facilitate easy removal. Where cleanout slots are necessary to remove setting sand or other debris, the separators can be an inverted V shape. They should be no higher than $\frac{2}{3}$ the thickness of the refractory concrete. The side forms and metal separators are removed as soon as the concrete has set sufficiently to support its own weight. On the first firing a crack will develop at the apex of the triangle and extend to the surface, thus dividing the car top into sections.

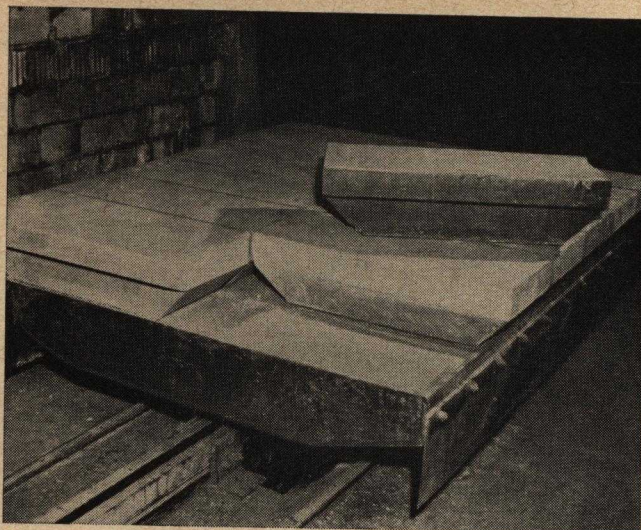
Cleanout slots are formed in other ways. Paper box-board is so cut and scored that the board is readily bent to give a triangular core. Plywood forms may also be used in the same manner. In either case the core form is left in place and burns out on the first trip through the kiln.

Summary: The use of refractory concrete (made with LUMNITE cement and special aggregates) for tunnel kiln car top construction and maintenance is gaining wide acceptance in plants making all classes of ware fired as high as cone 13 or 14. The cost is usually less than using other materials. For example, material and labor costs are lower and inventory is reduced. Refractory concrete in car tops means longer service life and greater stability — important considerations where expensive kiln furniture is used.

SPECIFY CASTABLES FOR CONVENIENCE

Where suitable aggregates are not readily available, special industrial concretes may be made with prepared castables (packaged mixes of LUMNITE cement and aggregates selected for specific temperature and insulating requirements). Castables are convenient and economical to use—all you do is add water, mix and place. Castables — products of accurately controlled cement-aggregate ratios, controlled aggregate quality and gradation — are made and distributed by leading manufacturers of refractories.

There are numerous applications for versatile industrial concretes made with LUMNITE cement in ceramic plants. For more information, write: Lumnite Division, Universal Atlas, 100 Park Avenue, New York 17, N. Y.



Precast refractory concrete car tops give long service, despite high temperatures and repeated thermal shock.



Car tops can be quickly cast in place with refractory concrete, using plant labor and equipment.



Various precast refractory shapes can be made with castables containing LUMNITE cement. Left to right: burner block used in a circular tunnel kiln; crown peephole block used in periodic kiln; and setting floor brick for circular tunnel kiln.

CDB-L-178

A. J. WAHL, INC.

General Offices and Factory: 2-8 CENTRAL AVE., BROCTON, NEW YORK

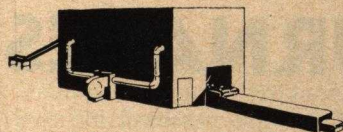
Telephone, Brocton, N. Y.—Sycamore 2-4205

Cable Address, "Wahlco"

WAHLCO

WARE CLEANING

Bisquemaster Tumbling Mill

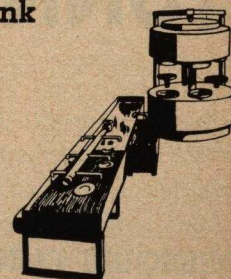


Cleans bisque quickly and thoroughly. Combines efficient tumbling action with "straight-through" production line methods. Ware and grog are fed continuously into mill and clean ware and grog constantly discharged at other end. Angle of tumbling tube adjustable for fast and slow production.

DECORATING PROCESSES

WAHLCO Decal Patter Conveyorized Soaking Tank

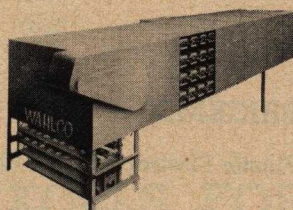
Mechanical aids for decalomania operations. Use together or separately . . . each is an independent unit. The Patter gently tamps the decal after it has been applied to the ware. Five ware holders insure continuous production on mixed shapes.



WAHLCO Air-Jet Dryer

The latest in modern, fast cycle drying can be used alone or integrated with the Trimatic and Rotomatic Jiggering-Drying Systems. More floor space available due to overhead drying zones. The jet air principle permits faster mold cycling with minimum drying losses. For drying Dinner-ware, Hotelware, Artware, Insulators, Tile and Special items.

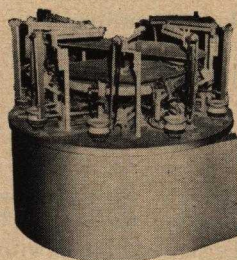
WARE DRYING



FINISHING PROCESS

WAHLCO Edge Finisher

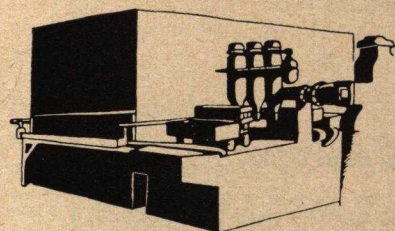
Machine finishing the edge of round jiggered items at production line speeds is now available with this WAHLCO unit. Production can be diversified. Requires only unskilled help. No dust hazard. Low upkeep and maintenance.



Eight and ten head models.

AUTOMATIC WARE FORMING SYSTEMS

TRIMATIC METHOD



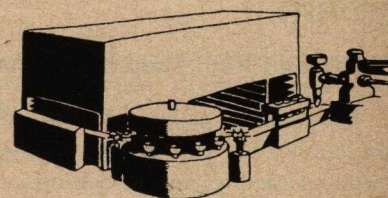
A high production System for forming and drying mixed round jiggered items. Latest type of power feeding.

Three feeders supplied by one pug mill. Controlled extrusion individual to each line. Automatic cut-off for accurate charge production. Excess clay is recycled. Drying by advanced air-jet method for short cycle, high speed efficient production. Output up to 250 dozen pieces per hour. Available in Holloware and Flatware models.

ROTOMATIC METHOD

Complete jiggering and drying system for single line operation on one, two or four different mold backs or faces in succession. Production speeds up to 120 dozen per hour. Minimum labor.

WAHLCO Air-Jet Dryer integrated with this system. Available in Holloware and Flatware models.



PRODUCTS AND SERVICES of A. J. WAHL, Inc.

Storage Mangles
Conveyor Systems
Insulator Presses
Plant Layout Service

Mangle Type Dryers
Presses
Clay Feeders
Foot Grinding Machines
Special Machine Building

Tunnel Type Dryers
Metal Mold Cases
Duomatic Jiggers
Engineering Service

REPRESENTATIVE—Continental Europe & India: Dorst-Keramikmaschinen-Bau, Kochel/OBB
Postscheckkonto 9915, Munchen (Munich), Germany

WELLSVILLE FIRE BRICK COMPANY

WELLSVILLE, MISSOURI

Refractories for

TUNNEL KILNS

INDUSTRIAL FURNACES

MISSOURI FLINT

A Missouri High Heat Duty Brick

An all purpose brick that will have some application in any kiln or industrial furnace. May be safely used up to the highest temperature zones in smelters, heat treating furnaces, checker chambers, tunnel kilns, etc.

All standard sizes stocked in carload quantities.

BANNER

A Missouri Super Duty Brick

For applications requiring high density combined with excellent spall resistance. Intermittently operated furnaces, metal melting, high temperatures zone in kilns, etc.

All standard sizes stocked in carload quantities.

MOHITE

A Missouri High Fired Super Duty Brick

The highest quality fire clay brick. May be used in any application within the range of fire clay. Especially recommended for metal melting and for applications requiring dimensional stability at high temperatures.

Stocked in all standard sizes.

DURALITE

A High Alumina Brick

Made in 50, 60 and 70% Alumina. For applications requiring a high melting point refractory.

Can be made in either standard sizes or special shapes.

SAVAGE

An Intermediate Quality Fire Brick

An economical brick for moderate service and back-up work.

Made and stocked in 9" straights only.

BRICKMIX

Plastic Firebrick In All Qualities

For all service conditions requiring a ramming type refractory. Made of fire clay, chrome, mullite, graphite or high alumina base materials, both with and without air setting properties, either fully prepared ready to ram or in dry condition for gunning.

BRICKSET

Mortars and Cements from 0-3000°F.

Made of various base materials and supplied either wet or dry, air setting or heat setting, in quantities from 25 lb. to a carload.

KASTITE

Hydraulic Setting Castables

Made in all standard ASTM grades and special base materials for special applications.

Shipped in dry form in 100 lb. bags.

WESTVACO CHLOR-ALKALI DIVISION

Food Machinery and Chemical Corporation

161 E. 42nd St., New York 17

Denver, Colo. St. Louis, Mo. Philadelphia, Pa. Chicago, Ill. Charlotte, N. C. South Charleston, W. Va.

SODA ASH - Na_2CO_3 (Sodium Carbonate)

UNIQUE AND BETTER

Westvaco Soda Ash is a unique and superior form of Sodium Carbonate produced at Westvaco, Wyoming from an immense deposit of unbelievably pure trona (sodium sesquicarbonate)—a relatively rare non-metallic mineral composed of hydrous sodium carbonate and sodium bicarbonate.

Typical Chemical Analyses

	Light ash	Dense ash
$\text{Na}_2\text{O}\%$	58.44	58.35
$\text{Na}_2\text{CO}_3\%$	99.88	99.75
$\text{NaCl}\%$	0.02	0.05
$\text{Na}_2\text{SO}_4\%$	0.02	0.05
Fe_2O_3 ppm	8	12

From this dissolved raw material, Westvaco recrystallizes pure sodium sesquicarbonate containing the equivalent of 70.34% sodium carbonate (soda ash). Calcining drives off excess carbon and contained water yielding Westvaco Soda Ash with these unexcelled properties:

Physical Forms

Grades: Light - Grade 100
Regular Dense - Grade 200
Glass Dense - Grade 300

Bulk density #/cu. ft.

Light ash 49.5

Dense ash 60.0

Containers: #100 lb., 4 ply paper bags and covered hopper cars of 63,000 #minimum.

WHY IT EXCELS FOR GLASS AND CERAMICS

Chemical Purity

Note the higher content of Na_2CO_3 and the consequent lower total impurities. Note also the low chloride, sulfate and iron content. Westvaco Soda Ash has less tendency to discolor solids or solutions because it is as chemically pure as a tonnage chemical can consistently be.

High Flowability

Westvaco Soda Ash is composed of millions of tiny needle-shaped crystals which actually act as "rollers" when the material is unloaded or handled. Thus, it does not agglomerate or cake up but instead flows freely.

High Surface Area / Unit of Volume

Unlike synthetic soda ash crystals which are essentially cube shaped, the needle-like crystals of Westvaco Soda Ash have higher surface area/unit of volume and therefore have an optimum melt rate in the furnace.

Less Tendency to Dust

Practical experience shows that the needle-shaped crystals of Westvaco Soda Ash do not tend to pulverize during normal loading, unloading or handling. There is distinctly less dusting, less physical stack loss during the melt and less tendency to choke up the checkers.

Rapid Complete Solubility

Rapid complete solubility makes Westvaco Soda Ash ideal as a deflocculant in the slip solution for whiteware. Its absence of insoluble impurities eliminates any tendency to discolor finished goods.

Unique Screen Analysis

Westvaco Soda Ash cannot be properly judged by screen analyses originally set up for the cube-shaped crystals of synthetic soda ash. Actual operating results show that Westvaco Soda Ash dusts less and has the optimum size / volume ratio for the desired melting times and working ranges in both flat and container glass.

Additional Information Available

Prices and delivery quotations, working samples, technical data and a copy of the 42-page *Westvaco Soda Ash Manual* may be obtained from any of the offices listed above.

WHITTAKER, CLARK & DANIELS, INC.

"The Talc House"

260 West Broadway



New York 13, N. Y.

A DEPENDABLE SOURCE FOR OVER SIXTY FIVE YEARS

ALUMINA ALCOA
Hydrated, Calcined, Tabular

FELDSPAR

MICA
Ground, Sheet

ANTIMONY OXIDE

FLINT

ORGANIC BINDERS
Irish Moss, Rice Starch

ASBESTOS

FLOURSPAR

PUMICE

BARIUM CARBONATE

GRAPHITE

PYROPHYLLITE

BARIUM SULPHATE

GROUND GLASS

BENTONITE
"Volclay," Powdered, Granular

GYPSUM
Terra Alba, Plaster of Paris

SILICA
Quartz, Neo-Novacite, Fluxing

CALCIUM CARBONATE
Natural and Precipitated

IRON OXIDES
Red, Black, Yellow, Ferrites

STEARATES
Aluminum, Barium, Calcium,
Magnesium, Zinc

CALCIUM SULPHATE

KAOLIN

STEARIC ACID

CERIUM OXIDE

LIME
Ground Limestone, Calcined

TALC
Calcined, Refractory, Saggars, Steatite,
Lo-Micron

CHALK

CLAYS
Ball, China, Kaolin, Domestic

MAGCAL®

TITANIUM DIOXIDE
Electronic

COLORS
Ceramic, Earth

MAGNESIUM OXIDE

VERMICULITE

CHROMIUM GREEN OXIDE

MAGNESIUM CARBONATE

WETTING AGENTS
Aquadyne, Hydrodyne

DIATOMACEOUS EARTH

MAGNESIUM TRISILICATE

WHITING

FERRITES
Barium, Manganese-Zinc, Nickel-Zinc

MAGNESIUM HYDROXIDE

WONDERSTONE

MAGNESITE

FINE GRINDING & BLENDING FACILITIES AVAILABLE. TRIAL LOTS PROCESSED.
PRESENT YOUR PROBLEMS TO US.

REFERENCE BOOKS AVAILABLE: "Talc," "Metallic Soaps" (Stearates),
"Calcium Carbonates," "Ceramics"

SALES REPRESENTATIVES

ATLANTA—Charles E. Baker, Inc.
CHICAGO—Harry Holland & Son, Inc.
DALLAS—Roy Ribelin Distributing Co.
DETROIT—Harry Holland & Son, Inc.
MEMPHIS, TENN.—L. E. Offutt Co.

NEW ORLEANS—E. W. Ortenbach
ORLANDO, FLA.—Palmer Supplies Co.
PHILADELPHIA—R. Peltz Company
CANADA—Dalex Corp. Ltd., Montreal
Chemiteria Ltd., Toronto

WILLIAMS PATENT CRUSHER & PULVERIZER CO.

Plant and General Offices

717 Montgomery St. — St. Louis 6, Mo.

SALES AGENCIES

Appleton, Wisc.....Machinery & Supplies, Inc., 110 N. Outagamie
Birmingham 3, Ala.....Chas. A. Herron, Jr., 339 Brown Marx Bldg.
Birmingham, Michigan.....Carl Beers Co., 19021 Hillcrest Bldg.
Boston, Mass.....Harris & Underhill, 446 Statler Bldg.
Chicago 44, Illinois.....John Law & Co., 5850 W. Lake Street
Cleveland 20, Ohio.....E. C. Swift Co., 3537 Lee Road
Denver 2, Colo.....Aldredge & McCabe, 847 E. 17th St.
Erie, Pa.....B. C. Klingensmith, 637 W. 10th
Greenville, S. C.....Hersey-Thomas Co., 44 Norwood Place
High Point, N. C.....Hersey-Thomas Co., P. O. Box 1375
Houston 5, Texas.....Glenn W. King, 2411 Times Blvd.
Knoxville 15, Tenn.....Power Equip. Co., Box 2311, 1634 Island Home S.E.
Memphis 1, Tenn.....Matthews Blow Pipe Co., 125 Keel St.

Nashville 10, Tenn.....Southern Machinery Co., Inc., 75 Trimble St.
New Orleans 12, La.....Kelleher Eng. Co., Suite 435, International
Trade Mart
New York 36, New York.....Woodrow W. West, 1472 Broadway
Oakland 20, Calif.....Cheney Machinery Sales & Parts Service, 600
16th Street
Pasadena 1, Calif.....Empire Equip. Corp., 385 E. Green Street
Pittsburgh 19, Pa.....Nelson Eng. Sales, 524 Grant Bldg.
Blue Bell, Pa.....W. L. Marple and Associates
Seattle 8, Wash.....Washington Machinery Co., 7329 E. Marginal Way
Tampa 3, Florida.....Minich-Duvon Corp., 2509 W. Hillsboro Ave.
Toronto 7, Canada.....Watt Machy. & Equip. Co., 454 King St., W.
Vancouver, B. C., Canada.....W. A. Akhurst Mach. Co., 215 W. 2nd Ave.

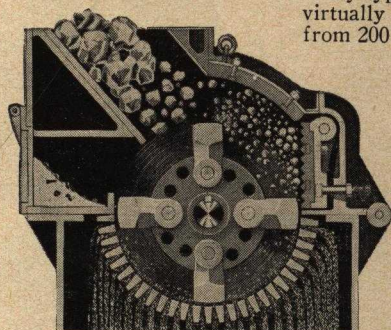
WILLIAMS

CRUSHERS GRINDERS SHREDDERS

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



Hammer Crushers

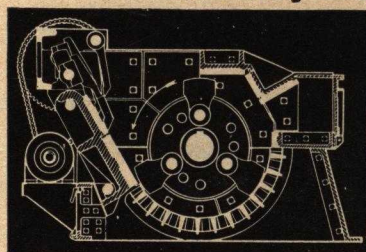


Many types, sizes and capacities for virtually every purpose, ranging from 200 pounds to 200 tons hourly.

Large sizes will reduce power shovel loaded material for feeding fine grinders or, depending upon material, to finished size in one operation without secondary grinders, extra drives, conveyors, and other equipment. Handles glass cullet, burned ware, grog, frit, wet clay containing lime pebbles, etc. Fast revolving hammers re-

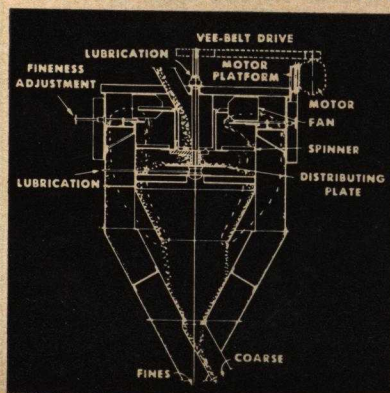
duce material by impact to pass through bar grate or screen with specified size openings. A special dustless type "Helix-Seal" Hammer Mill grinds many materials as fine as 300 mesh. Ideal for "mortar mix."

Non-Clog Crushers



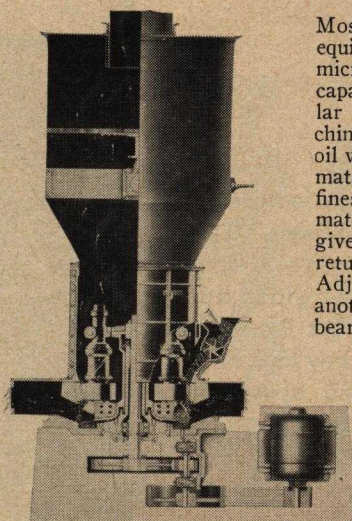
Will reduce wet clay, shale, marl, other sticky material to any practical size in a single operation. Patented "pusher feeders" force material into crushing zone. Keeps breaker plate clean. Thirty sizes available.

Mechanical Air Separator



Designed to extract fines and return oversize material to pulverizer for regrinding when operating in closed circuit with pulverizer, or to separate fines from dry ground material. Used to classify hundreds of raw materials and finished products such as high early strength cement, hydrated lime, silica, etc. Fed at top by gravity; discharges at bottom in two streams, fine and coarse. Adjustable from 20 to 325 mesh. Nine standard sizes with hourly capacities from 500 pounds to 75 tons.

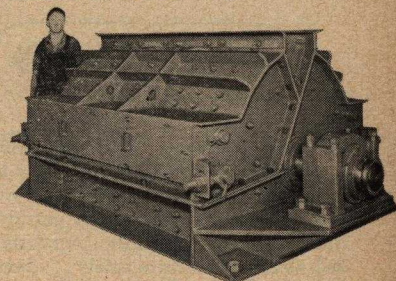
Roller Mills With Air Separation



Most efficient type of fine grinding equipment for 20 to 400 mesh, or micron sizes. Delivers greatest capacity per horsepower and dollar invested. Widely used for china clay, bentonite, fullers earth, oil well clays, feldspar, and similar materials. Mill is air swept so fines cannot cushion unground material. Accurate air separator gives positive check on fineness; returns oversize for re-grinding. Adjustable from one fineness to another while in operation. Roller bearing construction. Steel instead of cast iron construction at vital points. Laboratory to production sizes with 20-ton per hour capacity.

Reversible Impactors

Quick low-cost uniform reduction and sizing of non-metallic materials down to 35 mesh, or smaller with more friable materials. In closed circuit systems with vibrating screens, 100% product sizing at very low cost is obtained. Reversible rotation doubles service life of hammers, impact blocks, other wearing parts; reduces maintenance and replacement costs, and down-time. Parts last up to 7 times longer than other types of equipment. Strongly reinforced heavy-duty construction. Several sizes.



Impact Mills with Air Separation

Combines the accuracy of air separation with large capacity hammer pulverizing. Recommended for materials ground best by impact such as lime, fullers earth for bleaching, other similar work. Automatic throw-out for impurities. Sizes for all production jobs.

Dry and Grind Simultaneously

Both Williams Roller and Impact Mills will dry and grind by the introduction of hot air into the system. Wet solids containing up to 50% of moisture can be converted into dry powders of 100 to 400 mesh fineness.



WICKWIRE SPENCER STEEL DIVISION

THE COLORADO FUEL AND IRON CORPORATION

General Sales Office and Plant, 56 Sterling St., Clinton, Mass.

DISTRICT SALES OFFICES

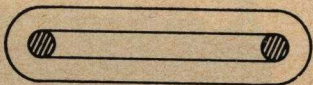
Atlanta, Ga., 934 Avon Avenue, S. W., Franklin 5561
 Boston 10, Mass., 80 Federal St., Liberty 2-6690
 Buffalo 2, N. Y., 361 Delaware Ave., Mohawk 5600
 Chicago 32, Ill., 3838 W. 51st St., Ludlow 5-8000
 Denver 2, Colorado, Continental Oil Bldg., Keystone 4211

Detroit 26, Mich., 1915 Nat'l. Bank Bldg., Woodward 1-4516
 New Orleans 18, La., 7930 Palm St., Galvez 2128
 New York 22, N. Y., 575 Madison Ave., Murray Hill 8-5400
 Oakland 6, Calif., 1080 19th Ave., Kellogg 2-2141
 Philadelphia 23, Pa., 225 W. Erie Ave., Garfield 5-4002

WISSCO LEHR BELTS

designed to increase efficiency . . . built to last longer, cut costs

Two important design features of Wissco Lehr Belts—Wissco's Thin Flat Spiral and Wissco's Welded Knuckle Edge—give glass and ceramic manufacturers those all-important "extras" they look for to improve heat-treating operations and affect substantial operating-cost savings.



Wissco's exclusive Thin Flat Spiral is formed thin and stretch-resistant—a lighter, stronger construction that provides a smooth, flatter supporting surface for greater loading capacity . . . carries even tall, slender stemware safely . . . distributes the wear over a large area . . . substantially reduces the major causes of belt trouble—stretch, distortion and breakup.



Trimming

Knuckling

Welding

Steps In Edge Preparation

Wissco's rugged, high-strength Welded Knuckle Edge is smooth, safe, provides maximum resistance to the natural wear and tear encountered in all lehr belt operations.

These Wissco features plus open mesh construction and a range of job-suited alloys give a lehr belt construction that is sound from both engineering and economic standpoints . . . that ensures even heating, prevents strain, bottom cracking and checking of the ware at points of support. The specified heat flows evenly and consistently through Wissco open mesh belts, to do its work on the ware being treated.

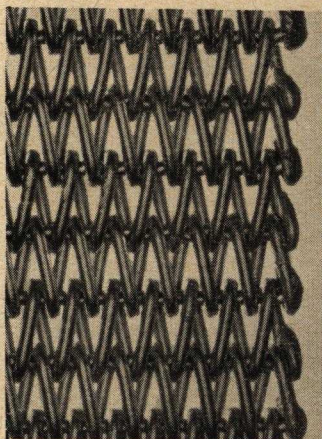
WISSCO LEHR BELTS



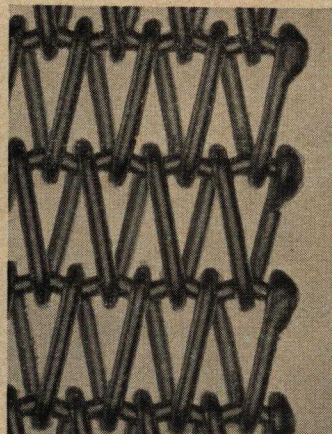
Standard Wissco Lehr Belts are available in Balanced Spiral weaves (illustrated below), Conventional Spiral and Straight Rod Reinforced Spiral weaves.

WISSCO STANDARD SPECIFICATION LEHR BELTS

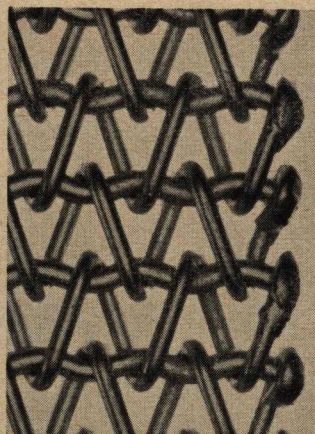
Belt Designation	lb./sq. ft. Approximate Wt.	Belt Designation	lb./sq. ft. Approximate Wt.	Belt Designation	lb./sq. ft. Approximate Wt.
60-38-14	4.50	36-41-14	3.00	24-27-12	3.30
60-21-12/14	3.65	36-30-12/14	2.95	24-25-10/12	4.00
42-41-14	3.31	36-20-12	4.00	24-22-11/12	3.00
42-27-14	2.63	30-30-11/12	4.56	24-22-12	2.95
42-20-10/12	5.00	30-20-10/12	3.65	18-16-11/12	2.22
42-18-12	4.40	30-24-12	3.34	18-16-12	2.00
		30-20-12	2.92		



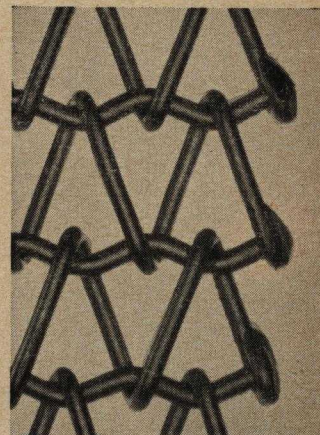
60-38-14



36-20-12



24-25-10/12



18-16-12

Wissco Lehr Belts are made from specially-processed steels having low thermal capacities. The belts absorb very little heat, and consequently do not radiate excess heat to the part of the ware that they touch. They are available in a selection of stainless steels, aluminized steels and low-

chrome alloy steels specifically selected for their high resistance to heat and corrosion. Wissco Lehr Belts give excellent service in glass and ceramics operations where temperatures up to 2100°F. are encountered.

POTTERY AND CERAMIC BURNING

Wisscoloy 16
(Type 309 Stainless)

Wisscoloy 18
(Type 314 Stainless)

Wisscoloy 21
(Nichrome V)

GLASS ANNEALING

Wiss-Cal-Lum
(Aluminized Steel)

Wisscoloy 12
(50 carbon)

Wisscoloy Chrome A
(1% Chrome)

Wisscoloy Chrome B
(2% Chrome)

GLASS DECORATING

Wisscoloy Chrome B
(2% Chrome)

Wisscoloy Chrome C
(3% Chrome)

WISSCOLOY CHROME A (1% Chrome) also contains molybdenum, silicon and other elements . . . designed for use where lehr speeds and temperatures are stepped up to increase production.

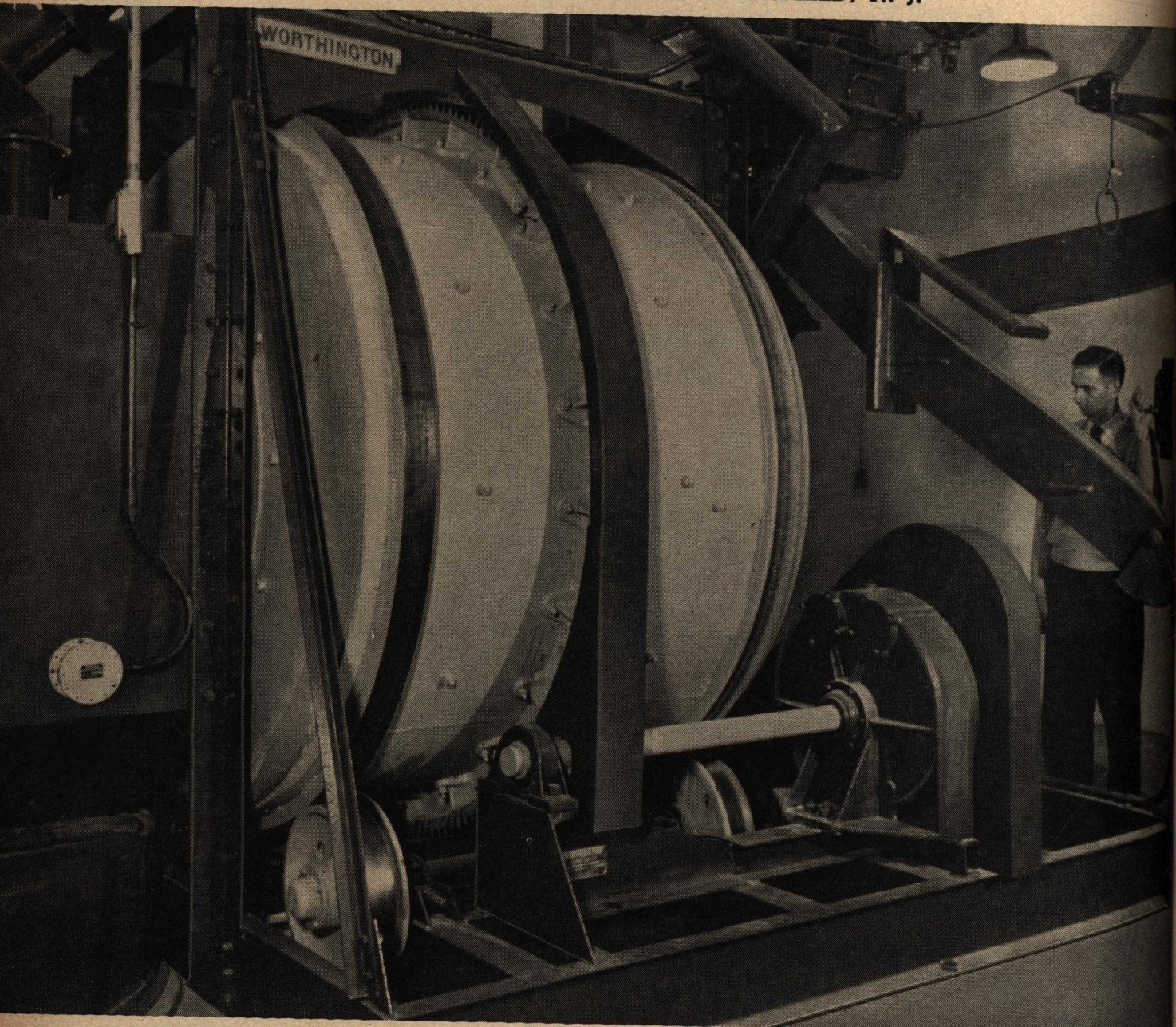
WISSCOLOY CHROME B (2% Chrome) recommended for decorating operations and for severe annealing work.

The 2% Chrome assures longer life at the higher temperatures required.

WISSCOLOY CHROME C (3% Chrome) the strongest and most corrosion-resistant of the standard alloys used in glass lehrs, it is recommended where decorating temperatures and belt speeds are increased to boost production.

6279

WORTHINGTON CORP.
INDUSTRIAL MIXER DIVISION — PLAINFIELD, N. J.



WHY WE CHOOSE WORTHINGTON MIXERS



JOHN L. KLUG, board chairman, J. L. Klug Corp., international designers and builders of complete batch plants, chooses Worthington glass batch mixers for today's finely controlled blending operations.

"The mixing secret's in the blade design," says John L. Klug,

board chairman of the J. L. Klug Corporation, Rochester, New York, "and they have other design advantages as well, particularly in low head room requirements and simple dust control."

A large number of Worthington Glass Batch Mixers with capacities ranging from 13 to 110 cu. ft. capacity have been installed for both domestic and foreign use by the J. L. Klug Corp., designers and builders of complete batch plants for the glass and alloy steel industries. Now in glass plants for nearly every major glass producer, Worthington dry batch mixers meet the varied requirements of these plants, giving complete mixing in the shortest possible time, complete discharge of all including finest materials in 30 to 60 seconds depending on mixer size.

"Worthington's drum-type batch mixers feature correct blade design for complete blending

even with today's finely controlled batching," according to Mr. Klug. And combined with the Klug Corporation's batching equipment, this design results in economical, efficient balanced-blending, clean charging and discharging, uniform batch after uniform batch.

The story of Worthington's dust-proof industrial mixers from drum-head feed opening through heavy-duty discharge chute is yours for the asking. Write for "How to Choose the Right Mixer for Your Requirements." Worthington Corporation, Section 55-6, Harrison, New Jersey.

WORTHINGTON



ZIRCONIUM CORPORATION OF AMERICA

31505 Solon Road - Solon, Ohio

ZIRCOA OFFERS

Stabilized Zirconium Oxide
Fabricated Zirconia Shapes
Monoclinic Zirconium Oxide
High Temperature Materials

INDUSTRIES AND USES

FOUNDRY

The properties of Zirconia can be used to advantage in many foundry applications. Zirconia is not wet by most molten metals and has a very low reactivity. The following are applications which have been successful for Nickel alloys, high temperature alloys, and Silica sensitive alloys:

Investment Casting Molds
Shell Mold Additive
Permanent Mold Coating
Permanent Molds
Powder Metallurgy Molds
Wash Coating
Vacuum Melting Furnace Liners

ELECTRICAL-ELECTRONIC

The low electrical resistivity of Stabilized Zirconia at high temperatures recommends its use as an electrical resistor. The high electrical resistivity at low temperatures suggests other uses. Some uses are:

Arc Chambers
Instrument Parts
Furnace Resistor Elements

Titanate Ceramics
Insulators

ABRASIVE

Zirconia has a definite future as an abrasive. Its physical structure compares to that of the best abrasive powders with superior efficiency reported in snagging wheels as

used for stainless steel.

Zirconia is an excellent glass polishing material and is widely accepted for polishing ophthalmic lenses.

REFRACTORY

In the refractory field, Stabilized Zirconia ("available in sub-sieve to -4 mesh particle size) is opening the door to new processes and is making new products available on a commercial scale. Every characteristic points to Stabilized Zirconia as the ideal refractory for modern use. Here are the Recommended Refractory Uses:

Ramming Mixes
Bricks, Shapes
Forge Furnace Bottoms
Skimmers
Stoppers
Tubes, Cores, Muffles
Furnace Skid Rails
Heat Exchanger Pebbles

Burner Blocks
Burner Parts
Kiln Furniture
Nozzles
Jet Engine Nozzles
Glass Feeder Blocks
Ladle Coating
Hearth Plates

CERAMIC

In the Ceramic Industries, Zirconium Oxide is used in special ceramic and glass applications as follows:

Laboratory Ware
Setter Plates for Titanates
Opacifiers
Chemical Resistant Glass
Special Optical Glass

FABRICATED SHAPES

Examples of standard items now available are:

Boats	Brick
Tubes	Setters
Crucibles	Spheres
Tile	Rods

Send for our catalogue of standard shapes.

Zircoa also specializes in custom forming, offering excellent service and delivery. Our trained technical personnel will gladly assist you in development and design for your special application.

An expansion of Zircoa's fabrication department now under construction will permit precision fabrication of a wide line of ceramics, cermets, and powder-mets involving such elements as zirconium, beryllium, uranium, thorium and hafnium.

SPECIALTY CERAMICS

Through an expansion of Zircoa's facilities, special ceramic materials and shapes can now be offered. Ceramic grains as magnesium and calcium zirconates, low expansion ceramics, cermets and powder-mets, including the rare earth and refractory metals and oxides, are also available on a custom basis.

HIGH-TEMPERATURE MATERIALS AND EQUIPMENT

Zircoa's brick, ram mixes and castables are available for high-temperature use in oxidizing and mildly reducing atmospheres. For the laboratory a versatile gas-fired pot furnace is now available as an assembled unit ready for use to 4600°F.

CHARACTERISTICS

Withstands high temperature—4700°F m.p., 4300°F use limit

Excellent thermal insulator—6 Btu/hr/ft²/°F at 1600°F, (1/9 of Magnesia)

Low reactivity—resists slag actions, bases and most acids at elevated temperatures

Low electrical resistivity—conductor at elevated temperatures.

High electrical resistivity—insulator at low temperatures.

Write today for free consultation on your engineering problems.

ZIRCONIUM
CORPORATION
of America

Manufacturers of zirconium oxides and refractories
Solon, Ohio

briefed..

FOR QUICK DECISIONS

A Summary of the Catalog Section

Here, to help you locate the materials or equipment catalogs you want to study, are condensed descriptions of every product illustrated in Ceramic Data Book.

If you need more information than the complete Ceramic Data Book catalogs provide, just check and mail the handy "More Information" coupons on page 335.

BALL AND PEBBLE MILLS AND MIXERS—The ball and pebble mills by Paul O. Abbé are made in a wide variety, of sizes. They are equipped with "all steel" cylinders and alloy steel trunnions and can be water cooled when desired. The line of mixers includes all sizes of ribbon mixers with various styles of ribbons available, depending upon the application. Also double cone blenders, cylinder mixers and other special types. Write for data. Paul O. Abbe, Inc., Little Falls, New Jersey.
(Circle No. 1 on Service Coupon)

SLIP MIXING—Abbé Dispersall Mixers designed for high speed mixing, milling and blending of slip for china and pottery ware. Scrap, either wet, plastic or dry, can be reprocessed in the Abbé Dispersall Mixer. Can be supplied for vacuum de-airing or jacketed for heating and/or cooling. Write for Catalog 78. Abbé Engineering Co., Dept. 51, 50 Church St., New York 7, N.Y.
(Circle No. 2 on Service Coupon)

ABBÉ GRINDING MILLS—For pulverizing, wet or dry grinding or mixing ceramic materials, glaze, colors, etc. Abbé makes a complete line of pebble mills, ball mills, tube mills, jar mills, mixers and sifters. Write for catalogs or technical advice. Testing laboratory and service available. Abbé Engineering Co., Dept. 51, 50 Church St., New York 7, N.Y.
(Circle No. 3 on Service Coupon)

ALCOA'S NEW CHEMICAL PLANT located at Bauxite, Arkansas, was completed in 1955 and is producing hydrated, calcined, and tabular aluminas of a higher degree of uniformity and purity than have been previously available to users. Facilities are available for special grinding, blending and sizing to meet the present anticipated needs of the refractory, ceramic, and chemical industries. Aluminum Co. of America, Pittsburgh, Pa.
(Circle No. 4 on Service Coupon)

BAUXITE—Aluminium Limited, one of the world's foremost producers of aluminum, is a reliable source of supply for bauxite and its derivative chemicals. For information on the various grades and types available, write: Aluminium Limited Sales, Inc., 630 Fifth Avenue, New York 20, N. Y.
(Circle No. 5 on Service Coupon)

ALUMINUM CHEMICALS FOR CERAMIC INDUSTRY—Aluminium Limited, producer of one-fourth of the free world's aluminum, will gladly supply you with information on the various aluminum chemicals available to the ceramic industry. Write: Aluminium Limited Sales, Inc., 630 Fifth Avenue, New York 20, N. Y.
(Circle No. 6 on Service Coupon)

CLAY MACHINERY—American Clay specialists are well equipped to help you solve your plant production problems. Whatever your needs—a spare part—a single machine—a complete layout—it will pay you to talk to an American Clay machinery specialist. American Clay Machinery, Division of Huber-Warco Company, Marion and Bucyrus, Ohio.
(Circle No. 7 on Service Coupon)

NEPHELINE SYENITE—"Lakefield". nepheline syenite is a crystalline granular igneous rock composed of nepheline, potash, feldspar, soda feldspar, having exceptional uniformity. It starts to sinter at cone 08 and has a P.C.E. of 6, or sintering range of about 13 cones. Because of its exceptional whiteness when fired, it has been adopted in the hotel china, semi-vitreous ware, sanitary porcelain and floor and wall tile bodies. It is an outstanding raw material for low temperature vitreous

bodies because it permits firing temperatures to be lowered as much as three cones. American Nepheline, Ltd., Lakefield, Ont., Canada.
(Circle No. 8 on Service Coupon)

NAME YOUR FRIT REQUIREMENTS—APEC frits are manufactured for every application, including sheet steel, cast iron enamels. The APEC frits are of exceptionally high quality because the batch has been afforded maximum efficiency and precise quality control. Careful checks are made on raw materials, material in process and the finished frit before shipping. Send for price schedule. American Porcelain Enamel Co., 1285 E. Keating Ave., Muskegon, Mich.
(Circle No. 9 on Service Coupon)

LITHIUM FOR CERAMIC USE—Now available is lithium carbonate and lepidolite ore. Lithium imparts durability, electrical resistance, and low thermal expansion enamels and glasses. Lepidolite is used directly in glass making for its content of lithia and fluorine, high total alkali and alumina, moderate silica and low iron. Technical data and samples available. American Potash & Chemical Corp., 3030 W. Sixth St., Los Angeles 54, Calif.
(Circle No. 10 on Service Coupon)

BORAX, A VERSATILE CERAMIC FLUX—The use of borax in enamel, glazes, as well as in glass is widespread. Pyrex glass depends on borax to give it its low thermal expansion qualities. Borax is a standard flux in porcelain enamels. Both borax and boric acid are essential in glazes. In salt glazing brick, coping, sewer pipe and electric conduits, borax and boric acid along with the salt materially improve the appearance of the ware. American Potash & Chemical Corp., 3030 W. 6th St., Los Angeles 54, Calif.
(Circle No. 11 on Service Coupon)

NO MAGIC OVERALL GRINDING FORMULA—For efficient crushing and grinding, the American Pulverizer Co. considers each and every job as an individual one with individual characteristics and requiring a tailor-made piece of machinery. The company manufactures equipment for crushing cullet, grog, limestone and clays, as well as rejects and dry pan tailings. They manufacture everything from the heavy type of brick bat grinders down to laboratory mills. They will be glad to recommend the most efficient crusher for your specific job. American Pulverizer Co., 1268 Macklind Ave., St. Louis 10, Mo.
(Circle No. 12 on Service Coupon)

WET WATER INCREASES PRODUCTION—When Aquadyne wetting agent is added, surface tension of plain water is lowered from 72 dynes to 30 dynes; water droplets are attracted to solid surfaces, quickly, efficiently. The Aquadyne system consists of the concentrated Aquadyne wetting agent capsule and the Hydroblender—producing up to 1,000-12,000 gallons of wet water. For product blending, the system gives faster mixing, minimum moisture required, faster drying time plus many other benefits. System also highly advantageous for dust control, for cleaning mixing equipment. Full literature and prices from: Aquadyne Corp., 89 Terminal Ave., Clark, N.J.
(Circle No. 13 on Service Coupon)

COMPLETE LINE OF INSULATING REFRACTORIES—The Armstrong Cork Co. has six types of insulating refractories for temperatures from 1600° to 2800° F. These brick are made to give a well balanced ratio of insulation value and strength. This is made possible through the use of stronger clays and Armstrong's special cork-burning-out process. The brick are light in weight, uniformly sized, have high resistance to shrinking and spalling and can be used directly exposed to either gas, oil or electric firing. Armstrong Cork Co., 950 Mulberry Street, Lancaster, Pa.
(Circle No. 14 on Service Coupon)

COMBUSTION CONTROLS—Getting maximum combustion efficiency from glass tanks, ceramics and refractory kilns, steam boilers is the aim of plant owners and operators. Bailey offers a complete line of meters, recorders, analyzers that do this job. For gas analysis, they have an oxygen-combustibles analyzer that continuously analyzes with high accuracy; measuring and recording devices are offered for furnace pressure; a pneumatically transmitting gas flow transmitter measures fuel flow. Free complete data on these, other instruments, controls, from Bailey Meter Co., 1083 Ivanhoe Rd., Cleveland 10, O.
(Circle No. 15 on Service Coupon)

CERAMIC MATERIALS—Ball clay, china clay, feldspar and research service are available from Bell Clay Operations. For complete service for pyrometric cones, fire check keys, fire check gauges contact the Research Laboratory. Bell Clay Operations, 157 Virginia Avenue, Chester, W. Va.
(Circle No. 16 on Service Coupon)

COLORS YOU CAN RELY ON—The dependability of their colors is a source of pride for this company, because their research is always at work improving product performance. Their glass enamels are low-firing, acid-resistant, sulphide-resistant, and alkali-resistant. The lineup also includes aluminum enamel frits, both lead and lead-free; low-temperature steel frits; glaze stains, extremely stable and low in cost; etc. They'll rush products literature to you upon inquiry. Berkshire Chemicals, Inc., 60 Greenway Drive, Pittsburgh 4, Pa.
(Circle No. 17 on Service Coupon)

TOP EFFICIENCY BURNERS AND AUXILIARY EQUIPMENT—Engineers, designers and manufacturers of oil, tar and gas burners, auxiliary equipment for the ceramic industry more than half a century, this company combines experience, technology in the Calorex planned-packaged burners for quick, easy, bolt-on installation. Incorporates pacemaking advances in burner design, automatic electronic controls for complete automation; guaranteed combustion performance. Literature on

the complete burner line, or engineering recommendations for your specific requirements available by writing W. N. Best Combination Equip. Co., 417 Eleventh St., Carlstadt, N.J.
(Circle No. 18 on Service Coupon)

CUSTOM MADE PLASTERS—The A-1 plaster which is used for pottery purposes is called K-55. This is a pure, evenly textured plaster that remains highly permeable in the set state. Where high absorption is required, this plaster is ideal. Compressive strength at pouring consistency is 2200 psi. Plaster for the plate glass plants, low expansion purposes. Booklet is available. Bestwall Certain-Teed Sales Corp., 120 E. Lancaster Ave., Ardmore, Pa.
(Circle No. 19 on Service Coupon)

SPRAY GUNS AND CIRCULATING SYSTEMS FOR CERAMICS—All Binks spray guns for use with ceramic materials have tungsten carbide inserts in nozzles and on needle valves to protect these parts from the abrasive action of the frit. Model 18VSS is equipped with a stainless steel head, nozzles and fluid needle which prevents metal contamination of the frit. Binks new PM-120 ceramic regulator, for the first time, permits the application of circulating systems to ceramic finishing. Binks manufactures a complete line of spraying equipment: automatic horizontal and vertical reciprocating spray machines, water-wash and dry-type spray booths, air supply and exhaust systems . . . everything for the ceramic finishing department. Engineering help and counsel on finishing problems available without obligation. Binks Mfg. Co., 3128-36 Carroll Ave., Chicago 12, Ill.
(Circle No. 20 on Service Coupon)

PRECISION GRINDING—For economical production on flat surfaces on glass, ceramics, stone, jewelry, the Blanchard Surface grinder is ideal. Finishes of two micro inches and flatness within one band of light are common procedure for a Blanchard. The Blanchard Machine Co., 64 State St., Cambridge 39, Mass.
(Circle No. 21 on Service Coupon)

CLAY WORKING MACHINERY FITTED TO YOUR NEEDS—Bonnot's 65 years' experience proves the value of clay working machinery tailored to your raw materials, plant and products, assuring highest product quality, greatest production speed at lowest ultimate cost. Complete line includes machinery for potteries and specialty manufacturers; de-airing machines, cutters, grinders, feeders and many other types. In addition, there are research facilities and direct parts replacement service when needed. The Bonnot Co., 721 Mulberry Rd., S.E., Canton 2, O.
(Circle No. 22 on Service Coupon)

FULLY-AUTOMATIC, CONTINUOUS FEEDER CONTROL—New Bonnot Flowmaster eliminates overloading and underloading of continuous processing units through accurate, electrical control of single or multiple (motor-driven or vibratory) feeding systems. Starts or stops feeding unit motors when load on the processing machine rises above or falls below pre-selected limits. Easily installed, the rugged Flowmaster improves product quality, cuts human error and saves labor dollars. The Bonnot Co., 721 Mulberry Rd., S.E., Canton 2, O.
(Circle No. 23 on Service Coupon)

SPRAY DRYING—Drying fine materials for processing can be controlled to any moisture content. Pressing bodies, raw materials are easily processed. It's already used in preparing tile clays, enamel clays, etc. Bowen Engineering, Inc., North Branch, N. J.
(Circle No. 24 on Service Coupon)

INDUSTRIAL LOCOMOTIVES—Brookville locomotives are made in 11 different sizes and weights with dimensions, gauges, couplers and speed range to suit all requirements. Standard and low mine types, with or without cabs, for hauling everything from small, narrow gauge cars to full size, standard gauge freight cars. All Brookville locomotives are furnished with high grade, readily serviced, standard power

plants for either gasoline, diesel or kerosene. Write Brookville Locomotive Works, Brookville, Pa.
(Circle No. 25 on Service Coupon)

HOW UNIFORM CAN IT GET?—Cabot's wollastonite, calcium metasilicate, is probably more uniform over an extensive deposit than any other ceramic raw material. Wollastonite main uses to date include wall tile bodies; vitrified grinding wheel bonds; glazes of all types and in all segments of the ceramic industry; terra cotta or open types of bodies allied to the structural products field; low loss dielectric insulators; glaze frits and color stains. Get your detailed information from: Godfrey L. Cabot, Inc., 77 Franklin St., Boston 10, Mass.
(Circle No. 26 on Service Coupon)

FASTER, MORE UNIFORM, CONTINUOUS ANNEALING AND DECORATING—Woven wire conveyor belts are widely used throughout the ceramic industry on such applications as feeder lines, annealing and decorating lehrs, pottery kilns and washing metal parts prior to porcelain enameling. Their all metal construction makes them ideal for the rigors of heat corrosion and moisture encountered in these processes. They can be woven from any metal or alloy and selection is made depending upon the process conditions under which they will be used. Open mesh permits free circulation of air and heat as well as flash drainage of wash solutions. Cambridge belts are also available in any length or width and with a variety of special side and surface attachments, if required. For complete information and catalog, write: The Cambridge Wire Cloth Co., Dept. S, Cambridge 8, Md.
(Circle No. 27 on Service Coupon)

STOP TILE VARIATIONS—Rely on precision made tools and dies by Cammerzell. The Cammerzell Tool and Die Works manufactures a complete line of finishing machines, mounting boards and tile shakers, as well as a line of steel dies to be used on tile presses. The fettling machine can be used in conjunction with any type of tile press. Send for details. Cammerzell Tool and Die Works, Inc., 650 Strawberry St., Trenton 8, N. J.
(Circle No. 28 on Service Coupon)

JUST PLAIN HEAT—Global heating element installation gives clean radiant heat in an oxidizing or a controlled atmosphere when necessary. Control of the atmosphere does not affect the heating schedule. Thus, close control of the temperature is available. In continuous electric kilns the useful life, with variable voltage control, ranges from 5000 hours up to 10,000 hours. A consulting service is available. The Carborundum Co., Global Div., Niagara Falls, N.Y.
(Circle No. 29 on Service Coupon)

CERAMIC RESISTORS—Ceramic resistors present uniformly reproducible characteristics in six compositions covering: (1) Negative temperature coefficient resistors, (2) Negative voltage coefficient resistors, (3) Resistors having essentially linear characteristics which offer dissipation capabilities from .25 watts to 154 watts and with good overload potential. Global resistors range in body size from ¼ in. long x 1/16 in. diameter up to 18 in. long x 1 in. diameter in cylindrical bodies. They are also available in disc bodies in some compositions up to 3½ in. diameter x ¼ in. thick. Global Div. of The Carborundum Co., Niagara Falls, N.Y.
(Circle No. 30 on Service Coupon)

TOMORROW'S KILN CAR FURNITURE—Advanced thinking by ceramic operators, combined with Carborundum's special purpose refractories, has increased profits for many plants. Applying these super refractories to setters and posts, girders and even to the car top itself reduced dead-load, extended performance life, cut maintenance costs and improved fuel efficiency. Experienced engineering staff available to help redesign car structures. The Carborundum Company, Perth Amboy, N. J.
(Circle No. 31 on Service Coupon)

briefed . .

FOR QUICK DECISIONS

A Summary of the Catalog Section

Here to help you locate the materials or equipment catalogs you want to study, are condensed descriptions of every product illustrated in Ceramic Data Book.

If you need more information than the complete Ceramic Data Book catalogs provide, just check and mail the handy "More Information" coupons on page 335

BETTER FOUNDATION FOR SUPERSTRUCTURES—Slim, strong, high-grade silicon carbide girders open up car-top for much better heat circulation. Load is more evenly distributed to prolong car-top life. These girders carry heavier loads without deformation, improve service from setters and posts. Their high heat conductivity contributes to excellent thermal shock resistance. More data available from The Carborundum Company, Perth Amboy, N. J.

(Circle No. 32 on Service Coupon)

PRE-TESTED "CERAMIC" COLORS—At Ceramic Color and Chemical Mfg. Co. all colors are pre-tested under conditions simulating those in the customer's plant. "Ceramic" colors are noted for their uniformity on repeat orders, and for the high degree of fidelity with which original samples are matched. Color problems are handled by experienced executives—men who know and understand the customer's conditions and requirements. Ceramic Color & Chemical Mfg. Co., New Brighton, Pa.

(Circle No. 33 on Service Coupon)

SPRAY EQUIPMENT—The Ceramic Color & Chemical Mfg. Co. offers Paasche spray equipment for porcelain enamel plants, glass plants, and potteries. Manually operated spray guns in many styles and sizes as well as automatic spray machines are available. Replacement parts stocked for prompt shipment. Write for details. Ceramic Color & Chemical Mfg. Co., New Brighton, Pa.

(Circle No. 34 on Service Coupon)

CLAY & REFRACTORY MACHINERY—Chambers Brothers Co. is equipped to analyze any factory problem and supply correct machines from a complete range of modern, efficient designs, offering the benefits of a wide experience in the manufacture of machines for structural clay products, refractories, and sewer pipe. Chambers Brothers Co., 52nd & Media Streets, Philadelphia 31, Pa.

(Circle No. 35 on Service Coupon)

SPECIAL EXTRUDING & PROCESSING MACHINERY—For a wide variety of industrial applications, Chambers offers the advantages of a broad experience in designing and building pelletizing machinery for chemicals and plastic bulk products . . . as well as grinding machinery and continuous heavy-duty mixers and feeders. We welcome your inquiry no matter how far afield it may seem from the clay and refractories industries. Our specialty is custom design and manufacture at fair prices. Chambers Brothers Co., 52nd & Media Streets, Philadelphia 31, Pa.

(Circle No. 36 on Service Coupon)

BARIUM CARBONATE—Fine, fluffy, free-flowing, precipitated barium carbonate for use throughout the industry. Write or wire for advice. Chicago Copper is prepared to give close personal attention to your problems. Chicago Copper & Chemical Co., Blue Island, Ill.

(Circle No. 37 on Service Coupon)

FOR ENAMELERS—Chicago Vit frits assure lower production costs through consistent uniformity, excellent workability, reduction of costly re-work, fewer rejects. The company has a complete line of hydro-cleaned air floated clays. The Vitra-Pump, a diaphragm type, is available in two sizes. Other enamel equipment such as regular and high density grinding balls and linings, magnetic separators, sieving equipment, ball mills and a complete line of colors are available. Send for catalog. Chicago Vitreous Corp., Cicero 50, Ill.

(Circle No. 38 on Service Coupon)

DO YOU HAVE PRESSING PROBLEMS? The presses, for refractories and clay products are of various sizes, however, all the wearing surfaces on all the presses are replaceable. Inserts are bronze, steel or phenolic resin. All high speed shafts are fitted with sealed roller gearings, low speed shafts with phenolic plastic inserts. Write for engineering service, as well as counsel on your mold equipment problems. Chisholm, Boyd & White Co., 57th & Wallace Sts., Chicago 21, Ill.

(Circle No. 39 on Service Coupon)

BOYD PRESS—These presses are designed for heavy clay products. More staple structures are produced with smooth surfaces good sharp edges, and better control over density. Ideal for refractories and structural clay products. Chisholm, Boyd and White Co., 610 W. 57th St., Chicago 21, Ill.

(Circle No. 40 on Service Coupon)

HARD SURFACING RODS—Coast Metals offers a new line of tube rods. Designed to meet demands for low cost, hard surfacing, these new high alloy tube rods combine maximum wear and resistance, with good welding characteristics. Coast Metals, Inc., Little Ferry, N. J.

(Circle No. 41 on Service Coupon)

PURE IRON OXIDE—This is a synthetic product for the magnetic ceramics industry. Specifically for soft and hard ferrites. A choice of 13 forms from yellow ferric oxide hydrate to black synthetic magnetite. Write to Columbian Carbon Co., Mapico Clay Unit, 380 Madison Ave., New York 17, N. Y.

(Circle No. 42 on Service Coupon)

KYANITE MAKES TOUGH REFRACTORIES—Modern refractory makers add Commercialores kyanite into the mix and thereby develop multi-crystal without fail. Important developments in the processing of domestic kyanite ore have made it possible for Commercialores to offer a purer, higher alumina kyanite than has previously been available. Company will supply detailed specifications, data and samples. Commercialores, Inc., 30 Church St., New York 7, N. Y.

(Circle No. 43 on Service Coupon)

WHEN THE HEAT IS ON, FELDSPAR COMES THROUGH—Consolidated Feldspar has pointed out that because feldspar is a natural glass forming mineral, it has always been used by the glass, pottery and porcelain enamel industries and it is a natural fluxing agent for whitewares bodies. Modernization of plants operated by Consolidated Feldspar insures the highest quality product, uniformly prepared. Write for data sheets. Consolidated Feldspar Dept. of International Minerals & Chem. Corp., Skokie, Illinois.

(Circle No. 44 on Service Coupon)

NEW SOURCE OF NEPHELINE SYENITE—High quality Nepheline Syenite is now being produced at the modern new plant built on a huge ore deposit at Blue Mountain, Ontario by Consolidated Feldspar Dept. of International Minerals & Chemical Corporation, with sales offices at Skokie, Illinois. With its new Blue Mountain Nepheline Syenite, in addition to its potash and soda feldspars, silica, potters flint and other products, Consolidated Feldspar will greatly expand its service to the glass, pottery and porcelain enamel industries.

(Circle No. 45 on Service Coupon)

WHAT TIME IS MORE COSTLY THAN DOWN TIME?—The Continental Gin Co., manufacturers of idlers for conveyor belts and other equipment, take pride in introducing a sealed Timken bearing idler. This product is prelubricated for longer life and minimum maintenance. Conveyor belts which link one department of the plant to the other, are essential in plant operation and if they break down, whole plants and crews of men must stand around (being paid). Learn how to build for continuous production. Write Continental Gin Co., Industrial Div., Birmingham, Ala.

(Circle No. 46 on Service Coupon)

LOW IRON SILICA—Silica sand with an iron content of .012% is supplied from the Midwest for all types of ceramic production. Special process of recovery grinding and packaging insures continued cleanliness. Continental Silica Co., P. O. Box 124, Somonauk, Ill.

(Circle No. 47 on Service Coupon)

PRESSES AND PUMPS—The Crossley Machine Co. prides itself in manufacturing a line of processing machinery of supreme quality. Their Style D ball mills are heavily constructed with large bearings. For pressing electrical porcelain, a hydraulic press is made in three sizes: Four and a half tons, 9½ tons and 22½ tons total pressure. The friction driven power tile presses are built especially for the manufacture of floor and wall tile. A four-cylinder slip pump is available. This pump provides a steady flow of slip. Get your catalog. The Crossley Machine Co., 301 Monmouth St., Trenton 9, N. J.

(Circle No. 48 on Service Coupon)

CONCENCO FEEDERS FOR VARIOUS CLAY PLANT APPLICATIONS—For accurate and continuous metering of clays and shales, the Concenco disc feeder offers low cost dependable service. It is now designed in a range of four disc sizes. Concenco balanced gate type and Concenco screw feeders produce even distribution of clays and shales to the head of Leahy vibrating screens. The gate type offers greater simplicity while the screw feeder is preferable for low head room conditions. The Deister Concentrator Co., Inc., 933 Glasgow Ave., Ft. Wayne, Ind., U.S.A.

(Circle No. 49 on Service Coupon)

HEATED SCREENS PROCESS DAMP MATERIAL—When the advantages of Flex-Elex heating are added to the Leahy's unblinding action that disposes of intermediate size particles, the result is an efficiency and capacity never before achieved in the screening field. A new jacket and mounting concept, plus entirely new arrangements in the electric circuit now add extra operating efficiency and lower current consumption to the already enviable records of the Leahy No-Blind Vibrating Screen. Expense of jacket cleaning labor is eliminated along with lost production time. Life of screen jackets is prolonged. The Deister Concentrator Co., Inc., 933 Glasgow Avenue, Fort Wayne, Indiana, U.S.A.

(Circle No. 50 on Service Coupon)

DENISON HYDRAULIC PRESS FEATURES SMOOTH, ACCURATE CONTROL—It is manufactured in a range from 1 to 75 tons. Operating and control features are widely interchangeable. Multipress also gives you the advantages of a complete line of standard accessory equipment, such as knockout or ejection cylinders, peeling attachments, hopper feeds, etc. If Multipress cannot meet your

needs, Denison engineers can design special ceramic presses. Denison Engineering Div., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, O.

(Circle No. 51 on Service Coupon)

TWO STRAIN ROD PRESSES—Denison builds many presses designed especially for the ceramic industry, including two-strain-rod presses. A two-strain-rod variation of the one-ton Denison Multipress Midget is available with manual or automatic control. Other two-strain-rod presses are available in capacities up to 50 tons. Denison ceramic presses offer vibratory ram action, adjustable speeds and other control features of the standard Multipress. Denison Engineering Div., American Brake Shoe Co., 1149 Dublin Rd., Columbus 16, O.

(Circle No. 52 on Service Coupon)

APLITE PROVIDES INEXPENSIVE SOURCE OF ALUMINA FOR GLASS—Dominion aplite has been continuously used for the past 16 years in the production of glass, and manufacturers of grinding wheels, tile, terra cotta, porcelain products and heavy clay products—including brick, may find Dominion aplite of advantage in their products. A few tests will determine any advantages. Samples will be submitted without cost or obligation. Dominion aplite is very uniform in chemical composition and particle size from shipment to shipment. Dominion Minerals Div., Riverton Lime & Stone Co., Inc., Piney River, Va.

(Circle No. 53 on Service Coupon)

DRAKENFELD SOLVES COLOR PROBLEMS—B. F. Drakenfeld & Co. has maintained a complete color service for solving color problems pertinent to the glass industry, claywares and porcelain enamels. Drakenfeld's keen knowledge of decorating techniques, is assisting more and more glass, pottery, porcelain enamel, tile and heavy clay products manufacturers to wipe out "color bugs," and to save time, materials and money. B. F. Drakenfeld & Co., Inc. 45 Park Place, New York 7, N.Y.

(Circle No. 54 on Service Coupon)

DUCON REMOVES 99 PERCENT OF DUST—Equipment operates as follows: Dust laden air enters lower collector chamber and receives centrifugal motion mixing with washing liquid. Coarser dust is removed from the air stream, spiralling upwards, first through the lower and then through the upper set of baffles and always in contact with the descending washing liquid. This equipment will not only clean the air of detrimental dust, but it will also recover valuable materials from overspray in glaze booths. The Ducon Co., 149 E. Second St., Mineola, L.I., N.Y.

(Circle No. 55 on Service Coupon)

LEAD SILICATE—Eagle-Picher lead silicate is a fusion product of pure litharge and silica with a PbO content of 85% by weight. It improves furnace operation in frit and glass manufacture and it is practically dustless with a particle size of minus 10 mesh, packaged in 100 pound and 50 pound net paper bags. Other Eagle-Picher products for the ceramic industry: Alsilo (lead alumina silicate), Denzox (dense lead-free zinc oxide), lead-free zinc oxide, powdered and free flowing pellets, sublimed litharge, litharge, powdered and free flowing granules, glass makers red lead, potters dry carbonate of white lead. Eagle-Picher Co., Cincinnati 1, Ohio.

(Circle No. 56 on Service Coupon)

INSULATION: High Temperature—Cements, fills, blocks, blankets, pipe coverings made of mineral wool for temperatures to 2300 F. facilitates precise temperature control. Uniformity of these insulations are under constant check at the Eagle-Picher Research Laboratories. Precise control over entire production process assures industry highest quality in the entire line. Meet Federal, ASTM, Navy specifications and Commercial Standards. Eagle-Picher Co., Cincinnati 1, Ohio.

(Circle No. 57 on Service Coupon)

SPECIAL REFRACTORIES—For almost half a century, Electro has been supplying special refractories for the ceramic industry. Their kiln furniture boasts rigid construction, "Electro" developed and patented floating construction, or the combination semi-floating construction. Joining their fine line of saggars, slabs, setters and posts are their newly developed duplex slabs—a new kind of sandwich that combines an inner material of silicon carbide with an outer facing of a neutral or acidic oxide, depending on the job requirements. Full data from: Electro Refractories & Abrasives Corp., 344 Delaware Ave., Buffalo 2, N.Y.

(Circle No. 58 on Service Coupon)

ENGLISH CLAYS CONTINUE RECORD UNIFORMITY AND HIGH QUALITY—Every characteristic essential to high quality, uniformity and reliability is found in the English china and ball clays produced by the English China Clays Sales Corp. That is why these clays are in universal use by ware manufacturers who demand the best. It is good, sound policy to standardize on these clays of widely known and recognized merit. English China Clays Sales Corp., 551 Fifth Ave., New York 17, N.Y.

(Circle No. 59 on Service Coupon)

SILICON CARBIDE AND ALUMINUM OXIDE FOR REFRACTORY USE—Silicon carbide and aluminum oxide are used in the production of super refractory cements, castables and refractory bricks and shapes. The Exolon Co. prepares these materials in many run of mill and split sizes for ready use by the refractory industry. The Exolon Co., 941 E. Niagara, Tonawanda, N.Y.

(Circle No. 60 on Service Coupon)

MULTI-DECK VIBRATING SCREEN—Developed for their own use in the sizing of silicon carbide and aluminum oxide abrasive and refractory grains, the principle on which the Exolon multi-form grader operates is equally adaptable for the handling of many ceramic products. Pioneers in the development of present-day high intensity induction magnetic separators, Exolon has introduced most of the features now generally accepted as vital to successful high intensity separation. The Exolon Co., 941 E. Niagara St., Tonawanda, N.Y.

(Circle No. 61 on Service Coupon)

F-R-H CERAMIC MACHINERY LINE COVERS VARIETY OF EQUIPMENT—The present F-R-H line of ceramic machinery includes many specially-engineered machines for the ceramic industry. Along with a complete range of de-airing machines for the production of brick, tile, pottery and related products, the Fate-Root-Heath Company also manufactures delivery belts, disintegrators, crushers, cutters (both hand and automatic), and automatic sewer pipe machines. The benefit of F-R-H engineering experience is available without obligation to the ceramic industry where production problems are concerned. Standard F-R-H machines have been adapted to many special production problems and special machines have been completely engineered to solve others. The Fate-Root-Heath Co., Plymouth, Ohio.

(Circle No. 62 on Service Coupon)

PLYMOUTH LOCOMOTIVES AVAILABLE WITH TORQUE-CONVERTER DRIVE IN CLAY PIT SIZES—Sizes manufactured range from 3 to 70 tons with a choice of gasoline or diesel power, mechanical or torque-converter drive. The most popular clay pit sizes, from 3 to 10 tons, now have torque-converters available with either gasoline or diesel engines. The torque-converter has changed the concept of a mechanical locomotive. Power transmission is smooth with minimum wheel slippage, controls are simplified and there is less fatigue on the operator with consequently higher efficiency over the work shift. Full information is available from: The Fate-Root-Heath Co., Plymouth Locomotive Works, Dept. CDB, Plymouth, O.

(Circle No. 63 on Service Coupon)

MACHINERY CO. HANDLES ANY CERAMIC PROCESS—The Fernholtz Machinery Co. has a complete line of ceramic equipment for any type of plant. For pottery and enameling there

is the Frantz FerroFilter; Fernholtz No. 69 jar mill; vibrating screens; Moyno pumps; pulldown and jiggers; ball mills and other whiteware equipment. For the tile industry Fernholtz handles the Clearfield miller mixers with dust hood, batch loaders and manual or air unloading. They handle tile presses manufactured by Wieland, and fettling tables which are automatic, motor driven, for cleaning and brushing of tile after leaving the tile press. Magni-Power magnets and magnetic troughs are among other items handled, as well as the Fernholtz Automatic Casting system. They have machinery for brick and clay products, too, such as hydraulic cutters, dry presses and auger machinery. Fernholtz Machinery Co., 8468-D Melrose Pl., Los Angeles 46, Calif.

(Circle No. 64 on Service Coupon)

CERAMIC SUPPLY SERVICE—For porcelain enamels flake frit, plants, furnaces and equipment. For the entire industry, clays, colors and supplies. Engineering service for all. Write for complete price list of supplies. Ferro Corp., 4150 E. 56th St., Cleveland 5, O.

(Circle No. 65 on Service Coupon)

WHITEWARES EQUIPMENT BY FIEDLER—C. O. Fiedler, manufactures a complete line of whiteware equipment. Besides this line are other general pieces of equipment such as exhaust blowers with capacities up to 20,000 CFM with temperatures to 1000 deg. F. The Fiedler ball mill is designed to fit your space requirements with overhead drive, side mount, or mounted under the mill. Get your catalog today. C. O. Fiedler, P. O. Box 16433, Vernon Branch, Los Angeles 53, Calif.

(Circle No. 66 on Service Coupon)

LITHIUM FOR CERAMICS—Foote Mineral Co. has pioneered for many years in the development of unusual minerals and chemicals for ceramics. Unique lithium chemicals have gained wide acceptance in the ceramic industry, making possible higher quality porcelain enamels, glazes and glass while reducing costs and increasing production. Detailed information about lithium chemicals and minerals is given in the booklet "Lithium in Modern Ceramics" a copy of which will be sent upon request. Foote Mineral Co., 436 Eighteen W. Cheltenham Bldg., Philadelphia 44, Pa.

(Circle No. 67 on Service Coupon)

PETALITE a "new" ceramic material provides many unique properties of interest to manufacturers of whiteware, refractories and structural clay products as well as glass. Among the benefits this Foote Petalite provides are . . . zero expansion bodies with unexcelled heat shock properties . . . conventional bodies with improved expansion characteristics which may be fired at faster schedules, and with reduced dunting loss . . . vitrified bodies which can be matured as many as SIX cones lower than normal firing temperatures . . . new, lead-free glazes which challenge conventional compositions on both cost and performance. Foote Petalite is now available in three commercial grinds—glass grade, milled grade and a new whiteware grade. Data sheets and technical information available upon request. Foote Mineral Co., 436 Eighteen W. Cheltenham Bldg., Philadelphia 44, Pa.

(Circle No. 68 on Service Coupon)

REMOVE IRON FROM SLIPS, GLAZES, ENAMELS—Frantz Wet FerroFilter Magnetic Separators, standard of the industry for more than 20 years, extract contaminating iron particles from all ceramic liquids and slurries. They are made in gravity, pipeline and underfeed models with capacities from 50 to 2000 U.S. gals. per hour. The type best suited to your needs may be selected from Bulletin 58-E. It gives tables of sizes and capacities; tells how they are made and operate; and how to install them. Write S. G. Frantz Co., Inc., P.O. Box 1188, Trenton 6, N.J.

(Circle No. 69 on Service Coupon)

TAKE IRON OUT OF DRY MATERIALS—Frantz FerroFilter Magnetic Separators are used throughout the ceramic industry for removing iron particles from all kinds of powdered and granular materials. Made in two sizes. Capacities 1 to 25 tons per hour, depending on moisture content, fineness and specific

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FOR QUICK DECISIONS

A Summary of the Catalog Section

Here to help you locate the materials or equipment catalogs you want to study, are condensed descriptions of every product illustrated in Ceramic Data Book.

If you need more information than the complete Ceramic Data Book catalogs provide, just check and mail the handy "More Information" coupons on page 335

gravity of the material. A completely enclosed eccentric-weight vibrator shakes the FerroFilter and makes the material flow through a stack of grids whose vanes are strongly magnetized by a direct current coil. Magnetic particles collect on the vanes and are securely held until the current is shut off. Bulletin 58-E contains complete data on sizes and capacities. Write S. G. Frantz Co., Inc., P.O. Box 1138, Trenton 6, N.J.

(Circle No. 70 on Service Coupon)

INDUSTRIAL FANS—70° to 1650°F.—Complete temperature range with a fan for every purpose, backward, radial, or forward curved fans for Industrial and Commercial purposes. Class I and Class II heavy duty fans and fans for unusual temperatures and processes widely used in glass and ceramic ovens and furnaces and material handling equipment. Complete line of coatings available for many unusual applications. Send for our technical bulletins and your requirements will be given careful consideration. Garden City Fan Co., 801 N. 8th St., Niles, Mich.

(Circle No. 71 on Service Coupon)

SPECIAL REFRACTORIES—One of America's most complete clay forming plants will make refractories in any shape no matter how complicated. Combustion chambers, radiant, backwalls, fire brick, saggars, stove liners, heating elements, vaporizer fins, just anything from clay refractory requirements. Gem Clay Forming, Inc., Box 500, Sebring, Ohio.

(Circle No. 72 on Service Coupon)

PIONEER AND VELVACAST CLAYS—Pioneer is used in all whiteware bodies equally well and is a blend. Velvacast responds quickly to electrolyte and still has a good deflocculating range. These clays are specially produced for the ceramic field. Send for further information and samples. Georgia Kaolin Co., 519 Pennsylvania Ave., Elizabeth 3, N.J.

(Circle No. 73 on Service Coupon)

PYROPHYLLITE—You can improve your refractories and ceramic bodies by using pyrophyllite. Refractoriness strength, low expansion, dunting, grazing are some of the properties which are modified by pyrophyllite. Get your information from Glenden Pyrophyllite Co., P. O. Box 2414, Greensboro, N. C.

(Circle No. 74 on Service Coupon)

PATENTED PROCESS POTASH FELD-SPARS—Glass, pottery and porcelain enamel industries derive added benefits from potash feldspars produced by an exclusive patented

electrostatic process. A partial list of the products using this process includes "Keene" Feldspar, in 20 and 200 mesh, for glass and pottery; "Alstead" Feldspar, 200 mesh for pottery, higher silica content for special applications; "Sand-Spar," 20 mesh (Feldspar Middlings) for glass. Storage facilities at Camden, N.J. and other U.S. ports for truck and rail delivery to the glass industry. Full details from: Golding-Keene Co., 1401 New York Ave., Trenton 8, N.J.

(Circle No. 75 on Service Coupon)

COMPACTING PRESS—Hamilton now offers the ceramic industry a compacting press which is completely new in design and one which eliminates contamination as well as powder loss of basic raw materials. Has 75 ton capacity. Important in high cost ceramic raw material pressing. Hamilton Division—Baldwin-Lima-Hamilton Corp., Hamilton, Ohio.

(Circle No. 76 on Service Coupon)

ELECTRICALLY HEATED SCREENS—Screen life has increased up to 800% by electric heating of screens. This fact is record with many companies in the heavy clay products field. For more information write to F. R. Hannon & Sons, 1605 Waynesburg Rd., S.E., Canton 7, Ohio.

(Circle No. 77 on Service Coupon)

REFRACTORIES FOR ALL PURPOSES—In general, Harbison furnishes fire clay refractories, mullite, super-duty, semi-silica, silica, high alumina, basic refractories. Also, ramming materials, insulating fire brick, acid-proof brick, plastics, castables, mortars, bonding motors and special clays. The complete line is carefully explained in a catalog. Send for it. Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh 22, Pa.

(Circle No. 78 on Service Coupon)

MATERIAL MIXING, DRYING AND GRINDING—Hardinge's grinding mills, tube mills are well known. Other equipment available such as: Electric Ear, constant-weight feeders, dryers, kilns and coolers, classifiers, scrubbers, thickeners and agitators. For efficient handling of materials, write for bulletins on any specific piece of equipment or a combined catalog. Hardinge Co., Inc., York, Pa.

(Circle No. 79 on Service Coupon)

QUALITY PRIMARY KAOLINS—These North Carolina primary kaolins are low in iron content, lowest in titanium content, and the only ones known to contain significant amounts of clay mineral halloysite. Long established Harris products include body clays Kamec for electrical porcelain, Sparks for chinaware; combination glaze and body clay Lunday, which is thermal shock resisting. All are fine white "safety clays" that improve bodies, control warpage. A trial is convincing; send inquiries to: The Harris Clay Co., Spruce Pine, N.C.

(Circle No. 80 on Service Coupon)

YOUR CHOICE OF KILNS—And your choice of fuels to fire any type of ceramic. Producer gas, oil and gas, electricity can be applied to kilns, firing any one of scores of ceramic products. High and low temperatures; straight and circular tunnel kilns, dryers, plant design, construction and equipment are available to all. Write for complete particulars. Harpor Ceramic Service Co., 35 E. Gay St., Columbus 15, Ohio.

(Circle No. 81 on Service Coupon)

COLORS - CHEMICALS - OPACIFIERS—Harshaw's materials used by the ceramic industry number in the hundreds. An aggressive research program is constantly developing higher quality and improved chemicals. Write for the Ceramic Materials catalog. The Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, O.

(Circle No. 82 on Service Coupon)

NEW BURNER LINE—Hauck Mfg. Co. has announced a new line of series No. 620-P vari-pressure low pressure air type burners for either oil or combination oil and gas. They are intended for multiple burnered kilns, furnaces, ovens, etc., where a group of burners are to be operated from one point to ratio and control the capacity of air and fuel by means of varying the pressures. Catalog No. 413 giving further details may be obtained by writing to Hauck Mfg. Co., 124-136 Tenth St., Brooklyn 15, N. Y.

(Circle No. 83 on Service Coupon)

GAS AND OIL BURNERS—Hauck manufactures gas and oil burners and equipment for kilns, dryers, lehrs and furnaces. Other products made are: Burner mounting plates and brackets, pumps, oil heaters, automatic shut-off valves, pressure relieve valves, oil temperature regulators and thermometers. Write for complete catalog and data on using gas and oil to: Hauck Mfg. Co., 133-134 Tenth St., Brooklyn 15, N.Y.

(Circle No. 84 on Service Coupon)

FILTER PRESS PLATES AND FRAMES—Plates and frames for all standard types of presses; grids for Moore and similar filters; wood parts for Oliver filters. Made from domestic and imported woods. Furnished plain or impregnated for longer life. Including metal parts of carbon steel, stainless steel, brass or Monel as indicated. Contact Hauser-Stander, 4822 Spring Grove Ave., Cincinnati 32, Ohio for information and prices.

(Circle No. 85 on Service Coupon)

SILICA BRICK FOR ROOFS—Pioneer manufacturers of refractory products, they supply silica brick for longer roof life. Both regular and super duty for open hearths, electric furnaces, copper refining furnaces, and glass tanks—available. Special shapes for port arches, burners, blocks, etc. available. Write or call home office for literature and technical service. Haws Refractories Co., 407 Main St., Johnstown, Pa. Phone 7-5375.

(Circle No. 86 on Service Coupon)

FIRST QUALITY CLAY BRICKS—Manufactured from the famous Dean Clays—specialize in checkers, also cupola and rotary kiln blocks. Also standard sizes and special shapes for the glass—pottery—copper and zinc industries. Write or call home office for further information and technical service. Haws Refractories Co., Johnstown, Pa. Phone 7-5375.

(Circle No. 87 on Service Coupon)

RARE EARTH CHEMICALS—The only producer in the U.S. owning and operating its own mines, HMC mines rare earth source materials, processes them at its modern Chattanooga plant into mixed and individual rare earth chemicals and thorium. Also available are rare earth oxide and salts, cerium-free rare earth oxide and salts, and didymium (classical) oxide and salts. One of these materials will probably fit the application you have in mind; free informative booklet available from: Heavy Minerals Co., 4000 N. Hawthorne St., Chattanooga, Tenn.

(Circle No. 88 on Service Coupon)

ENGINEERING FOR THE CERAMIC INDUSTRIES—Complete plant design, tunnel kilns, dryers, consulting service covering plant modernization, lower operating cost, appraisals and just anything in ceramics. Write to Dwight B. Hendryx & Associates, 6621 Darlington Rd., Pittsburgh 17, Pa.

(Circle No. 89 on Service Coupon)

FRITS AND COLORS—The world's most complete ceramic supplier includes glass colors, ceramic colors, pottery frit, porcelain enamels, enameling clay, enamel colors and oxides and hundreds of chemicals and equipment. Available for immediate delivery. Technical advice and samples are available without obligation. The O. Hommel Co., P.O. Box 475, Pittsburgh 30, Pa.

(Circle No. 90 on Service Coupon)

CERAMIC CLAYS—Seven grades of kaolox clays, a kaolin type, available; air-floated or water-washed. Each has varying physical characteristics and specifications and each is designed to meet a specific ceramic requirement. Samples and complete specifications available from J. M. Huber Corp., 100 Park Avenue, New York 17, N.Y.

(Circle No. 91 on Service Coupon)

REFRACTORIES—Goose Lake ground fire clay, fire clay flour, fire clay brick, Firex, grundite bond clay—Chem-Brix, silica and carbon — Thermo-Flake insulation, coating, brick, L. B. block, concrete. Write for folder: Illinois Clay Products Company, Barber Building, Joliet, Illinois.

(Circle No. 92 on Service Coupon)

CLAY WORKING MACHINERY—The new type 20E 10 ft. grinder has the world's highest grinding capacity. For refractories and better shapes there is the heavy duty special dry press. The Vac-Aire de-airing pugmill and auger is used for brick, fire brick, tile and sewer pipe. Pottery-porcelains are extruded through de-aired International augers. For kiln cars, there are no better. Write for full particulars to International Clay Machinery Co., Dayton 1, Ohio.

(Circle No. 93 on Service Coupon)

TALC FOR CERAMICS—Ceramitalc is used by the largest ceramic manufacturers. It is produced from practically inexhaustible deposits and processed specifically for wall tile, floor tile, dinnerware, artware, saggers and special refractory bodies. Upon request, practical working samples of Ceramitalc furnished free of charge to prospective users. International Talc Co., Inc., 90 West St., New York 6, N.Y.

(Circle No. 94 on Service Coupon)

INSULATING BRICK, FIRE BRICK, REFRACTORIES—Lightweight fuel savers for high temperature industrial equipment. Johns-Manville supplies complete line of brick, hydraulic-setting refractories, lightweight aggregates, fills and bonding mortars for economical control of heat through 3000 F. Write for booklet giving complete details. Johns-Manville, 22 E. 40th St., New York 16, N.Y.

(Circle No. 95 on Service Coupon)

COMPLETE LINE OF INSULATIONS—Each made to serve a specific purpose and used for every kind of process equipment and piping for service temperatures from minus 400 F to 3000 F above. Write for complete details and your free copy of the J-M Ready Reference Chart of Johns-Manville Insulations, their make-up and their range. Johns-Manville, 22 E. 40th St., New York 16, N.Y.

(Circle No. 96 on Service Coupon)

BALL CLAYS-PLASTIC FIRE CLAYS—The whiteware industry as well as the refractories industry can have ball clays or plastic fire clays to suit requirements for their products. Kentucky-Tennessee offers a choice of eleven pure plastic clays and mixtures of them. Write for additional information and samples to Kentucky-Tennessee Clay Company, Alliance, Ohio.

(Circle No. 97 on Service Coupon)

NEW CLAY CONDITIONER—Born after six years of laboratory experimenting, three years of plant testing, and now field tested in production of millions of brick—K-C new clay conditioner, Additive-A adds multiple benefits in brick, structural clay products and clay pipe production. It's in liquid form, easily added to the tempering water. Improves plasticity and strength, results in more efficient production, higher yields and more profitable operation. For complete data on Additive-A, and K-C engineering services available, drop a line to: Kimberly-Clark Corp., Box C-57, Neenah, Wis.

(Circle No. 98 on Service Coupon)

KYANITE—The use of Virginia Kyanite imparts good mechanical and thermal strength, raises resistance to thermal shock and controls shrinkage. Kyanite is an inexpensive source of alumina and has low iron content. PCE 36-37. Write for samples and detailed information.—Kyanite Mining Corporation, Dillwyn, Virginia.

(Circle No. 99 on Service Coupon)

MULLITE FOR REFRACTORIES—Mullite is now used worldwide in all types of bodies in the refractory and ceramic field. Ideal for saggers, electrical porcelain, laboratory ware, etc. Improve your refractories with Mullite. Write for samples and detailed information. Kyanite Mining Corporation, Dillwyn, Virginia.

(Circle No. 100 on Service Coupon)

DRYERS—No matter the type, whether they be humidity control dryers, table type conveyor dryers, batch type dryers, laboratory dryers, overhead conveyor continuous dryers, Lanly designs and builds them in many sizes, capacities and arrangements. Get your illustrated catalog now. Recommendations submitted without obligation. The Lanly Co., 766 Prospect Ave., Cleveland 15, Ohio.

(Circle No. 101 on Service Coupon)

DRYERS—Porcelain enamel dryers, dryers for curing decals on chinaware and frit dryers, all available in batch or continuous models. Recommendations submitted without obligation. The Lanly Co., 766 Prospect Ave., Cleveland 15, Ohio.

(Circle No. 102 on Service Coupon)

NEW AND REBUILT CERAMIC EQUIPMENT—Over 50 years experience supplying the ceramics and heavy clay products industries with first class processing machinery. Large stock in Metuchen and other convenient points. Lawler is both manufacturer and commission merchant. For full list of equipment available write to: Lawler Co., Durham Ave. & L.V.-R.R., Metuchen, N.J.

(Circle No. 103 on Service Coupon)

INSTRUMENTATION FROM MATERIALS TO PRODUCTS—Hundreds of ceramic manufacturers are finding these technically advanced instruments are doing an outstanding job of increasing production quotas by close measurement and control of variables found in high-quality mass manufacture. Offered are a complete line of instruments for industrial process measurement and control; instruments for plant and laboratory checking and testing; and complete "systems engineering" service for new plants or modernization programs. For instrument catalog or engineering data, just write: Leeds & Northrup Co., 4914 Stenton Ave., Philadelphia 44, Pa.

(Circle No. 104 on Service Coupon)

LITHIUM COMPOUNDS—There are 10 available lithium compounds for enamels and glazes . . . aluminates, titanates, zirconates, and many others. Add combinations of these oxides to your glasses for best result. For further information on how to use them, write to: Lithium Corp. of America, Inc., 2650 Rand Tower, Minneapolis 2, Minn.

(Circle No. 105 on Service Coupon)

ELECTRONIC CERAMIC EXTRUSION—A new 75 ton hydraulic press will easily and accurately extrude aluminum oxide, ferrite, stearite and other ceramic materials. Capacity is increased. Cylinders are abrasive resistant. Send for free literature today. Loomis Engineering and Manufacturing Company, Rt. 46 near intersection of Clinton Rd., Caldwell, N. J.

(Circle No. 106 on Service Coupon)

TILE AND DINNERWARE SETTERS—A new improved setter designed to last longer and give greater tile and dinnerware firing efficiency. Available in many sizes, Louthan setters withstand fast firing cycles, won't crack, dent or spall, and are easily stacked. For full information write to The Louthan Manufacturing Co., Subsidiary of Ferro Corp., East Liverpool, Ohio.

(Circle No. 107 on Service Coupon)

FIRING RACKS AND POTTERY SUPPLIES—Made of high fire refractories. Louthan firing racks and pottery supplies such as pins, posts, etc. are designed to simplify setting of ware and assembling settings on kiln cars. Available in a wide range of sizes and styles. For full information write The Louthan Manufacturing Co., Subsidiary of Ferro Corporation, East Liverpool, Ohio.

(Circle No. 108 on Service Coupon)

GRINDING EQUIPMENT—Quality grinding balls, porcelain mill lining brick, high density mill lining brick, door block, special frame lining brick, metal-covered and all-porcelain laboratory grinding jars for roller and cradle-type machines, mill head assemblies to modernize your present ball mills. McDanel Refractory Porcelain Co., Beaver Falls, Pa.

(Circle No. 109 on Service Coupon)

DEPENDABLE, UNIFORM CERAMIC CHEMICALS—Two qualities of their products which make this company proud are their dependability and uniformity. Available is a complete line which includes tin oxide (SnO₂), Maxopaque (porcelain enamel opacifier) and chromium oxide (Cr₂O₃) among many others. Supplementing these chemical products is a complete line of basic ceramic materials. Get all the details from: The McGeen Chemical Co., 1040 Midland Bldg., Cleveland, O.

(Circle No. 110 on Service Coupon)

IRON SPOTTING CAN BE ELIMINATED—Magni-Power Company of Wooster, Ohio are manufacturers of permanent magnetic equipment, unexcelled in the field of iron extraction. Iron particles ranging in size from nuts and bolts to ferrous particles of micron size are our specialty. For the larger pieces of iron, we manufacture heavy duty magnetic plates, troughs, pulleys and drums. For small ferrous particles our Magnetic Filter, an exclusive development of Magni-Power Company, is a new concept of iron extraction. Especially designed for the ceramic industry it is adaptable for both dry materials, such as, frits, glazes, clays, flints, feldspar, and ceramic slips. Write or call home office for literature or technical advice. Magni-Power Co., Box 122, Wooster, Ohio. Phone: HOWard 2-9896.

(Circle No. 111 on Service Coupon)

BELT CONVEYERS—Whatever the product to be handled—stone, brick, building blocks, tile, chinaware, or glass products—there are Mathews conveyers to do the job easily and economically. Whether the requirement is for a few sections of roller or wheel conveyor, a portable belt conveyor, or a complete conveyor system, it is a job for Mathews engineers. Contact the Mathews Conveyor Co., Ellwood City, Pa.

(Circle No. 112 on Service Coupon)

DRAFT GAUGES—Meriam draft gauges are standard equipment on most ceramic applications for control of combustion and temperature distribution throughout kilns and drying ovens. Furnished for one, two or three indications. For complete information, request Catalog C-12. The Meriam Instrument Co., 10920 Madison Ave., Cleveland 2, Ohio.

(Circle No. 113 on Service Coupon)

INSTRUMENTATION—Complete line of Meriam manometers which offer the highest sensitivity and accuracy in the measurement of pressures, flows and drafts for the ceramic industry. U-type, Well-type and Inclined-type manometers are described and listed. Pressure gauges measuring both gauge and absolute pressure are included. Draft gauges for kilns and ovens are also shown. For details on the entire line, request Meriam Catalog C-12. The Meriam Instrument Co., 10920 Madison Ave., Cleveland 2, Ohio.

(Circle No. 114 on Service Coupon)

ENAMEL AND GLAZE OPACIFIERS—M & T is headquarters for opacifiers. For enamels there are sodium antimonate, antimony oxide, zircon, zirconium silicate. For glazes there are tin oxide, Ultrox and ULTROX "500W."

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M & T also specializes in tin and antimony chemicals. Write for details and technical service. Metal & Thermit Corp., General Offices, Rahway, N.J.

(Circle No. 115 on Service Coupon)

MILLER DOUBLE ROTOR HAMMERMILLS—Made in several different models. Can be used as a primary, secondary or tailings reducer. Superior preparation of material from 50 TONS per hour through 8 wire per in. of screens to 100 TONS per hour of minus 8 mesh. Rugged construction. Replaceable hammers and tips. Miller Equipment Co., P.O. Box 1566, Salisbury, N.C.

(Circle No. 116 on Service Coupon)

MILLER "CROS-FLO" TUNNEL KILNS—New Miller Cros-Flo principle successfully dries and fires the most difficult material and produces select brick production. Higher quality, better uniformity. Unequalled Fuel Economy. Can furnish 4, 6 and 8 brick widths. For full information contact Miller Equipment Co., P.O. Box 1566, Salisbury, N.C.

(Circle No. 117 on Service Coupon)

COLORS OF PRECISION—Whether you're decorating semi-porcelain, china, hotelware, artware, tile or sanitaryware, you can benefit from the 112 years of Mason's cumulative experience. Colors are brilliant and intense; extra-finely ground and the palette is complete. Matching service available. Write, wire or phone today for full information and prices. Mason Color & Chemical Works, Inc., East Liverpool, O.

(Circle No. 118 on Service Coupon)

AIR AND HYDRAULIC CYLINDERS PROVIDE LOW COST, EFFICIENT, VERSATILE POWER FOR EVERY NEED—The ceramic industry is learning rapidly how to employ cylinders for pushing, pulling, clamping, pressing, feeding, guiding, locating, lifting, lowering, etc. Cylinders are easy to install, operate and maintain. Full data available from Miller Fluid Power Div., Flick-Reedy Corp., 2002-08 N. Hawthorne Ave., Melrose Park, Ill.

(Circle No. 119 on Service Coupon)

AIR-OIL BOOSTERS PROVIDE UP TO 10,000 PSI FROM SHOP AIR—Economically replace conventional pumps in many applications. Hold pressure indefinitely—without motion, heat generation or additional use of air. Ideal for clamping, pressing, testing, stamping, marking, riveting, punching, etc. Extremely simple, low cost operation and maintenance. Complete data from Miller Fluid Power Div., Flick-Reedy Corp., 2002-08 N. Hawthorne Ave., Melrose Park, Ill.

(Circle No. 120 on Service Coupon)

AUTOMATIC POTTERY MACHINERY—For ware forming, cup handling, drying, ware dressing, banding, stamping; or to answer other pottery problems involving production costs or quality control. A Miller representative will be glad to discuss and assist you in your immediate or long-range plans. Write to: Miller Pottery Engineering Co., Pittsburgh 18, Pa.

(Circle No. 121 on Service Coupon)

CUP HANDLING MACHINE—Popular in Europe, a novel cup-handling machine originated in England is now available in the U.S.A. Advantage is in the absolute uniformity of the joining pressure applied as well as in the control over handle centering on cups. Write to: Miller Pottery Engineering Co., Pittsburgh 18, Pa.

(Circle No. 122 on Service Coupon)

TEMPERATURE MEASURING INSTRUMENTS—Brown Instruments aid production. Wherever ceramics are made, Brown instruments are at work. For glass production, forehearth control, tunnel kiln heat measurement, pressures, Brown supplies instruments. A nearby field engineer will answer your request for more information. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

(Circle No. 123 on Service Coupon)

STOP GREEN SCUM—The addition of minor amounts of ground fluorspar to the batch during pug-milling of buff burning clays, has been found effective in nullifying vanadium efflorescence on brick surfaces. One-half percent to 1½ percent of CaF₂ added by a dry reagent feeder corrects all but very highly contaminated clays by vitrifying vanadium salts at about 1600 deg. F. and also makes possible better color control and fuel savings. Ask for trial sample. Minerva Oil Co., Eldorado, Ill.

(Circle No. 124 on Service Coupon)

LOW COST KILN FURNITURE—New Castle provides individual attention by experienced personnel and makes a thorough study of your furniture requirements to assure you of getting the right refractory for your needs at the lowest possible cost. Detailed information available for the writing. New Castle Refractories Co., New Castle, Pa.

(Circle No. 125 on Service Coupon)

ZINC OXIDE IS GOOD FOR CERAMICS—It is beneficial to ruby, window, opal and optical glasses. It aids all types of glazes and is used extensively in sheet iron and cast iron enamels. Best results are obtained by proper choice of specific types. For information on selections of zinc oxides for various applications, write for Technical Bulletin to The New Jersey Zinc Co., 160 Front St., New York 38, N.Y.

(Circle No. 126 on Service Coupon)

PELLETED ZINC OXIDE CUTS COST FOUR WAYS—The free-flowing and 50 percent lower bulking of XX-32 zinc oxide provides these advantages: (1) Decreases handling costs, (2) Saves valuable storage space, (3) Increases calcining capacity, (4) Reduces loss from dusting. For detailed information on XX-32 zinc oxide, write to The New Jersey Zinc Co., 160 Front St., New York 38, N.Y.

(Circle No. 127 on Service Coupon)

PYROPHYLLITE REFRACTORIES—Sturdy refractories are made from pyrophyllite in many forms. Plastic one-piece furnaces are built of pyrophyllite refractories and repairs are easily made. Paco car tops are used the industry over, Paco firebrick are designed for repeated firings. All Paco products, as well as other refractories are best cemented with Paco. Castable cements and high temperature cements. North State Pyrophyllite Co., Inc., Greensboro, N.C.

(Circle No. 128 on Service Coupon)

REFRACTORIES AND ABRASIVES—Application of Norton refractory and abrasive products are widespread in the ceramic field. Norton refractory and abrasive engineers in scores of cities are available at any time for prompt, expert aid in technical problems. Call on them if you need refractories; call on them if you have an abrasive problem or write in for information. Norton Co., Worcester 6, Mass.

(Circle No. 129 on Service Coupon)

GRINDING MACHINES—A wide range of precision grinding machines are available from Norton Co. The standard line includes cylindrical, surface, tool and cutters, universals, roll grinders, camshaft and crankpin grinders and lapping machines. Special purpose grinders can be designed. Most of these machines are designed for semi-automatic operation and some can be adapted to automation. Norton Co., Worcester 6, Mass.

(Circle No. 130 on Service Coupon)

FLUORSPAR FOR GLASS, PORCELAIN ENAMEL AND STRUCTURAL CLAY PRODUCTS—In glass and porcelain enamel it's a flux. In structural clay products it's the only known compound that will prevent the green scumming of buff burning clays. It completely nullifies the action of vanadium in scumming. Complete information is available. Write to: Oglebay, Norton & Co., Hanna Bldg., Cleveland 15, Ohio.

(Circle No. 131 on Service Coupon)

METAL PALLETS AND TRAILERS—Steel or aluminum for drying brick and ceramics. These pallets are professionally manufactured. Trailers and hand trucks (4-wheel type) are made from specifications or stock items are available; various platform sizes. Write for folders on both items. The Ohio Galvanizing & Mfg. Co., Niles, O.

(Circle No. 132 on Service Coupon)

ZIRCON AND RUTILE—Serving the entire ceramic industry. Orefraction engineers welcome the opportunity of working with you in developing new uses and improving product quality and production efficiency in your present uses for rutile and zircon. Write them for details. Orefraction Minerals, Inc., Andrews, S. C.

(Circle No. 133 on Service Coupon)

STANDARD PYROMETRIC CONES—All cones are machine made, with de-airing being used in the production of the large cones. Large cones are 2½ in.; small cones are 1½ in. Range of cones is 022 to cone 20. Write today for "The Properties and Uses of Pyrometric Cones." It's free. The Edward Orton Jr. Ceramic Foundation, 1445 Summit St., (P.O. Box 146, Sta. A) Columbus 1, O.

(Circle No. 134 on Service Coupon)

SERVICE, QUALITY, RIGHT PRICE—the motto of these importers who for almost three-quarters of a century have offered a large selection of highest quality clays to the ceramic industry. Technical service and storage facilities are offered with prompt attention to your needs at the lowest price available with respect to the fine quality given. Free samples of their china clays, ball clays, molochite (aluminous grog) and ceramic colors are offered; data and technical service available upon request. Contact: Paper Makers Importing Co., Inc., Easton, Pa.

(Circle No. 135 on Service Coupon)

NEW PK LIQUID FEED BLENDER mixes water or color oxides into clay bodies fast, economically, in one operation. Discharges quickly. Easy to clean. No extra steps for pulverizing, mulling or screening. New mixing action gives complete dispersion in minutes. Write The Patterson-Kelley Co., Inc., 10 Warren St., East Stroudsburg, Pa.

(Circle No. 136 on Service Coupon)

POTTER MATERIAL HANDLING—Patterson is the industry's headquarters for dependable ceramic equipment since 1865. Not only are they experts in pottery material handling, but in the rest of the ceramic field, from the finest to the toughest problems in refractories and structural clay products. Write for complete literature to: The Patterson Foundry & Machine Co., East Liverpool, O.
(Circle No. 137 on Service Coupon)

MATERIALS FOR CERAMIC COATINGS—Pemco is the first to devote its complete effort and facilities toward reaching the ideal 3-fold goal of combining objective research and development, dependable production and competent service in order to further the growth of the ceramic industry. Available are glaze frits, glass colors, grinding wheel frits, porcelain enamel frits, enameling clays and new additions. Contact the Pemco Corporation, Baltimore 24, Md. or representatives in your area.
(Circle No. 138 on Service Coupon)

CERAMIC MOVIE—16 mm color and sound movie tells how frits for glazes, porcelain enamels and other ceramic materials are made. Available free for showing to clubs, meetings, etc. Need 60 days notice. Pemco Corp., Baltimore, Md.
(Circle No. 139 on Service Coupon)

TAILOR MADE SILICA—Scientifically controlled, milling and precision classification enable us to produce a grade of ground silica to your exact specifications, in addition to offering a complete range of standard grades. For complete information and samples of highest-quality, perfectly uniform silica products, write to Pennsylvania Glass Sand Corp. or Pennsylvania Pulverizing Co., Two Gateway Center, Pittsburgh, Pa.
(Circle No. 140 on Service Coupon)

HIGH QUALITY SILICA PRODUCTS—Silica is your most important raw material. Be sure the silica products you use are of unequalled purity and perfect uniformity. For complete information and samples of glass sand, placing sand, refractories sand, Potters' flint, enameler's quartz and ground silica, write to Pennsylvania Glass Sand Corp. or Pennsylvania Pulverizing Co., Two Gateway Center, Pittsburgh, Pa.
(Circle No. 141 on Service Coupon)

ENGINEERED KILNS—Kilns engineered to your service, for research, for production, for pilot plants. Broad temperature ranges, varied work capacities and exact control features are available in the many standard types of Pereco electric kilns. No temperature is too high, no range is too wide, no problem too difficult. Write for catalog and service today. Pereny Equipment Co., Dept. CD, 893 Chambers Rd., Columbus 12, O.
(Circle No. 142 on Service Coupon)

PERECO FACTORY-BUILT sectionalized electric tunnel kilns, in either "Sliding Plate" or "Car Type", are quickly assembled for volume production right on the job location—and just as quickly dismantled for moving or relocating. This new series of kilns has silicon-carbide elements in three individually-controlled banks and provide accurately controlled operating temperatures of 500°F. to 2600°F. They're supplied complete with hydraulic pusher assembly and all temperature and power controls and are offered in a range of sizes and modifications to meet individual requirements. Pereny Equipment Co., Dept. CD, 893 Chambers Rd., Columbus 12, Ohio.
(Circle No. 143 on Service Coupon)

SERVICING THE BRICK AND CERAMIC INDUSTRY—Just to list a few machines available to the ceramic industry—soft mud machines, dry press machines, clay preparation, brick plant accessories, brick dryers, batch

mixers. Whether your problem is in glass, enamel, whiteware, refractories or structural clay products, Posey has the answer. Write for the catalog and find out what it is. Posey Iron Works, Inc., Brick Machinery Div., Lancaster, Pa.
(Circle No. 144 on Service Coupon)

KILN PLACING REQUISITES—Standard and specially-engineered devices for supporting ceramic ware through modern "firing" processes. Serving tableware, tile, insulator, steatite, sanitary, art and novelty industries since 1891. Catalog No. 59 lists standard Pin-Rite line of pins, stilts, spurs, thimbles, etc., describes famous P-38 pins for color-glazed ware. Write The Potters Supply Co., E. Liverpool, O.
(Circle No. 145 on Service Coupon)

PIN-RITE—The hallmark of specially-engineered devices for supporting ceramic ware during modern "firing" processes. Line includes pins, stilts, spurs, thimbles and specialties in Catalog No. 59. Features famous P-38 formula for placing color-glazed ware—appreciably reduces pin-markings, scratches, nipped ware; eliminates "pull-outs", provides ample supporting strength through handling and firing. Write The Potters Supply Co., E. Liverpool, O.
(Circle No. 146 on Service Coupon)

CONVEYING AND COLLECTING CERAMIC MATERIALS—Systems complete with pneumatic air conveying (Mikro-Airacn) and dust collecting (Mikro-Collector) equipment, for handling ceramic materials in processing or storage. Filtration tests are available through company's laboratory facilities without obligation. Send for new illustrated bulletins on these and other products. Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 65 Chatham Road, Summit, N.J.
(Circle No. 147 on Service Coupon)

PULVERIZING CERAMIC MATERIALS—Mikro-Pulverizers and Mikro-Atomizers for grinding materials are available in various sizes, grinding 5 to 30,000 lbs. per hour. Test grinds are available thru company's Laboratory and Test Grinding Departments, without obligation. Send for new illustrated bulletins on these products, and Confidential Test Grinding Data Sheet. Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 65 Chatham Road, Summit, N.J.
(Circle No. 148 on Service Coupon)

PLASTIC PRESSING IS RAPID—Up to 6,000 pieces per eight hours can be pressed by this plastic method by only two operators. It is a mechanical plastic pressing of ceramic shapes in gypsum-cement dies. The Ram process enables instant release of the formed piece by the application of fluid pressure through the permeable die. Write today for further information and available engineering service. Ram, Inc., 1064 W. Fifth Ave., Columbus, O.
(Circle No. 149 on Service Coupon)

OVERHEAD CONTINUOUS CONVEYORS—The R-W No. 2035 continuous power conveyor is a revolutionary development of continuous power conveying. Advantages are—low original cost, especially good in ceramic field; no sprockets; moving parts are completely housed and parts are standard. You can get all the information about it by writing to Richards-Wilcox Mfg. Co., 2176 Third St., Aurora, Ill.
(Circle No. 150 on Service Coupon)

COMPLETE REFRACTORY SERVICE—For furnace blok, castable refractories and refractory bonding mortars, the products of Refractory & Insulation Corp., are specifically made to meet all temperatures. Car tops, furnace walls, roofs, all can be made and repaired with these products. Temperatures up to 3000°F.

are easily contained in Kerractory & Insulation Corp. products. Refractory & Insulation Corp., 120 Wall Street, New York 5, N. Y.
(Circle No. 151 on Service Coupon)

SPECIAL REFRACTORIES—Dependable refractories made especially for the ceramic field are available from Remmey. Kiln furniture, car tops, saggars, refractory brick and laboratory kilns of highest quality are also available. Illustrated booklet available on all ceramic products. Richard C. Remmey Son Co., Philadelphia 37, Pa.
(Circle No. 152 on Service Coupon)

ORGANIC BINDERS—For refractories, sewer pipe, brick, drain tile, conduits, saggars, pottery, electrical porcelain, etc. Goulac is powdered; Glutrin is liquid. Send for your trial order. Robeson Process Co., P. O. Box 960, Erie, Pa.
(Circle No. 153 on Service Coupon)

FANS FOR ALL PURPOSES—Backed by over 50 years experience in designing and building fans and blowers, Robinson is serving the requirements of the Ceramic Industry. The equipment supplied ranges from fans for cooling and ventilating up through combustion air fans, waste heat fans, dryer recirculating and exhaust fans, high temperature recirculating fans, cooling fans for glass tanks and machine molds. Ask for our bulletins. Send a description of your air handling problems. Robinson Ventilating Company, Zelenople, Pennsylvania.
(Circle No. 154 on Service Coupon)

ROCKFACER—Enhancing the surface of brick after it is fired is accomplished by Rockfacer. Losses can be turned into profits with a simple operation. Rockfacer Co., 503 Hickory Tree Road, Mesquite, Tex.
(Circle No. 155 on Service Coupon)

DOMESTIC FLUORSPAR—Acid and ceramic grade—Rosiclare brand—for glass, porcelain enamel and structural clay products. Rosiclare Lead and Fluorspar Mining Co., Rosiclare, Ill.
(Circle No. 156 on Service Coupon)

LEAD-FREE ZINC OXIDES—St. Joe zinc oxides are supplied in powder form, packed in paper bags or in wood barrels. One grade, Green Label No. 43-P2, is available as dustless, free-flowing granules. Technical representatives will be glad to discuss your special requirements for zinc oxide. Write for list of representatives. St. Joseph Lead Co., 250 Park Ave., New York 17, N. Y.
(Circle No. 157 on Service Coupon)

CERAMIC MATERIALS—Samrak brands of ceramic raw materials includes airfloated iron chromite, manganese, rutile, zircon, fluorspar, beryl, ilmenite, kyanite, tungsten, petalite, and lepidolite. Source is reliable and grinding specifications adhered to. Write to Frank Samuel and Company, Inc., Philadelphia National Bank Bldg., Philadelphia 7, Pa., for information.
(Circle No. 158 on Service Coupon)

AUTOMATIC WEIGHER—The Poidometer automatically weighs material in motion on conveyor belt. Feed and weigh raw materials at the same time. The Poidometer is accurate, adjustable and dependable. Write for catalog N. 10. Schaffer Poidometer Co., 2828 Smallman St., Pittsburgh 22, Pa.
(Circle No. 159 on Service Coupon)

GLASS PLANTS—Complete new glass plants and equipment or modernization of existing factories for manufacturers of pressed and blown ware—tubing, rolled or drawn flat glass. Expert engineering service. Arthur W. Schmid Co., Investment Bldg., Pittsburgh 22, Pa.
(Circle No. 160 on Service Coupon)

briefed . .

FOR QUICK DECISIONS

A Summary of the Catalog Section

Here to help you locate the materials or equipment catalogs you want to study, are condensed descriptions of every product illustrated in Ceramic Data Book.

If you need more information than the complete Ceramic Data Book catalogs provide, just check and mail the handy "More Information" coupons on page 335

SHENANDOAH FLINT—A superior product for fine ceramic wares. It is widely known throughout the industry for highest quality and uniformity. Recent increase in capacity assures prompt shipment at all times. Write for samples and information. Shenandoah Silica Co., Inc., Trenton, N.J.

(Circle No. 161 on Service Coupon)

TUNNEL KILN REFRACTORIES—Complete line of setters, saggars, cranks, spiders and all auxiliary refractories needed for the production of all whiteware products is available, made to your specifications. Manufactured for all ranges of temperature and for all sizes and types of ware. Specialty work in refractories also solicited. Shenango Refractories Div., of Shenango China, Inc., New Castle, Pa.

(Circle No. 162 on Service Coupon)

SMALL BATCH MULLER—Though designed primarily for laboratory or pilot plant service, the new LF $\frac{1}{4}$ to $\frac{1}{2}$ cu. ft. Simpson Mix-Muller is also finding wide usage in preparing small batches of ceramic materials such as clay for artware and refractory daubing material. Shipped complete with motor, starter, dust cover and integral base, close control over mulling pressure is provided by spring-load device. For details, write for Bulletin 515. Simpson Mix-Muller Div., National Engineering Co., 632 Machinery Hall Bldg., Chicago 6, Ill.

(Circle No. 163 on Service Coupon)

NEW CERAMIC BULLETIN—A new bulletin on Simpson Mix-Mullers describing the use and application of the muller-type mixer in preparing ceramic materials is available. Included is descriptive material on mulling Refractories, Gunner and Artware; Electrical Porcelain; Floor and Wall Tile and Structural Clay Products. Specifications, dimensional and descriptive data on 12 models of the Simpson Mix-Muller are included, as are instructions for arranging for laboratory mixing tests on materials for preparation by mulling. For details, write for Ceramic Bulletin, Simpson Mix-Muller Div., National Engineering Co., 632 Machinery Hall, Chicago 6, Ill.

(Circle No. 164 on Service Coupon)

WAX EMULSION BINDERS AND PROCESSING AIDS—S/V Ceremuls added in small quantities to non-plastics and to floor tile and abrasives improve pressing and extruding properties; eliminate or reduce water require-

ment; impart green strength. The whole story is told in Bulletin CI-2, Socony Mobil Oil Co., Inc., 26 Broadway, New York 4, N. Y.

(Circle No. 165 on Service Coupon)

KAOLINS FROM GEORGIA—No. 27 and No. 600 are water washed kaolins. They are good for casting, for plastic processes and dry mixes. They are strong and have good firing color. For full details write to Southern Clays, Inc., 33 Rector St., New York 6, N. Y.

(Circle No. 166 on Service Coupon)

AIR HANDLING—Noted for stationary vacuum cleaning systems, portable vacuum cleaners, and turbo compressors is the Spencer Turbine Co. Pottery and enamel plants constantly use the vacuum system. Kiln cleaning is made easy with the vacuum system. Spencer portable and stationary systems are described in Bulletin No. 155. Write for it. The Spencer Turbine Co., 507 New Park Ave., Hartford 6, Conn.

(Circle No. 167 on Service Coupon)

INDUSTRIAL SULPHURS—Stauffer Chemical Co. supplies every type of industrial sulphur from producing points and warehouses coast to coast. Of particular interest is the Triangle Brand commercial flour sulphur, available in 50 lb. multiwall paper bags. Other grades include fine to coarse flour and screened lump. Stauffer Chemical Co., 380 Madison Avenue, New York 17, N. Y.

(Circle No. 168 on Service Coupon)

BORATES—Stauffer supplies B₂O₃ for quality ceramic products in the form of anhydrous, pentahydrate, and decahydrate borax, as well as boric acid. Available in 100 lb. multiwall paper bags, drums, and bulk. Stauffer Chemical Co., 380 Madison Avenue, New York 17, N. Y.

(Circle No. 169 on Service Coupon)

EXTRUDED CLAY PIPE—A new, fully automatic horizontal auger extrusion pipe operation provides for the forming, finishing, and palletizing of the smaller sizes of pipe. One man supervises the automatic pugging, extrusion and forming. A second man supervises the automatic finishing and palletizing. For details contact J. C. Steele & Sons, Inc., Statesville, N. C.

(Circle No. 170 on Service Coupon)

FANS AND BLOWERS—Cooling fans for kilns, high temperature fans, ventilator fans and blowers, man-cooling fans, penthouses and roof ventilators, duct fans, exhaust fans, and axial type blowers are featured in Bulletin No. 954A. Write for your copy to The Stevenson Company, Wellsville, Ohio.

(Circle No. 171 on Service Coupon)

BALL AND PEBBLE MILLS—Duplex Mill is available in a full range of capacities, with a variety of linings. Uses one drive for two Roller Bearing Mills, which can be operated independently. Saves power and space. A full range of lined or unlined, jacketed or un-jacketed Mills of all sizes, with individual drives, is also available. Write for details to The Stevenson Company, Wellsville, Ohio.

(Circle No. 172 on Service Coupon)

CERAMIC PRESSES—For any compacting or pressing, no matter what the material, no matter what the size . . . Stokes Equipment has a press for it. Single stroke punch presses,

rotary presses, hydraulic presses and many others are available for electrical porcelains, electronics, electrical tile and so forth. F. J. Stokes Corp., 5500 Taber Road, Philadelphia 20, Pa.

(Circle No. 173 on Service Coupon)

CRUSHING, GRINDING, MIXING—That's the business of Sturtevant, and a complete line of mills, mixers, crushers, air separators, for large production and even for laboratory machinery is available. The company's slogan is, "Anything in reduction, separating, conveying and processing machinery." Catalogs are available. Sturtevant Mill Co., 6 Harrison Sq., Boston, Mass.

(Circle No. 174 on Service Coupon)

HEATING AND HEAT TREATING EQUIPMENT FOR CERAMICS—Glass lehrs, bending furnaces, decorating lehrs, decorating kilns, mold heating ovens, television tube lehrs, are among equipment available. If yours is a problem dealing with an old or new heating application, it will pay you to call a Surface Combustion engineer. A card or phone call will get the service. Surface Combustion Corp., Toledo, O.

(Circle No. 175 on Service Coupon)

TUNNEL KILNS—For the fine ceramic, structural clay products and refractories industries, kilns are available as direct fired, multi-burner, full muffle and semi-muffle, circular, conveyor, recirculating gas tube and the new Unifab, from the lowest temperatures to cone 35. For specific details, a representative will call. Just write to: Swindell-Dressler Corp., Pittsburgh 30, Pa.

(Circle No. 176 on Service Coupon)

SALT GLAZING IN TUNNEL KILNS—An entirely new method for salt glazing in tunnel kilns with intermittent salting and full automatic control of the process is now in successful operation. Considerable fuel savings are available in comparison with previous methods with a more uniform and evenly developed glaze than heretofore realized. For details write Swindell-Dressler Corp., P. O. Box 1888, Pittsburgh 30, Pa.

(Circle No. 177 on Service Coupon)

VIBRATORY EQUIPMENT—Vibrating feeders, vibrating screens and grizzlies, vibrating batch weighing plants and all accessory equipment are available for smooth and efficient moving of raw materials in ceramics. Complete catalogs on request. Syntron Co., 750 Lexington Ave., Homer City, Pa.

(Circle No. 178 on Service Coupon)

SPECIAL REFRACTORIES—Sillimanite feeder parts and fore-hearth refractories, kiln furniture, saggars and plates are available in special compounded bodies of selected raw materials for longer life, to resist tougher conditions. For complete data write for Bulletin No. 202, or ask for specific refractories required. The Chas. Taylor Sons Co., Cincinnati 14, Ohio.

(Circle No. 179 on Service Coupon)

FELDSPAR AND SILICA—Specifically prepared for glass makers, rigid manufacturing control assures consistent high quality of every shipment. Samples from pilot plants are now available. Write for yours immediately. C. Tennant, Sons & Co., 100 Park Avenue, New York 17, N. Y.

(Circle No. 180 on Service Coupon)

LITHIUM ORE—Made specifically for the ceramic industry, spodumene, which is the lithium ore is available anywhere in the United

briefed

FOR QUICK DECISIONS

... THIS DEPARTMENT
(Pgs. 326 to 337)

SUMMARIZES parts of the
catalog section and lists
additional products **NOT**
cataloged

FOR YOUR CONVENIENCE a new
department . . . "Briefed for Quick
Decisions" . . . is included in this issue
of CERAMIC DATA BOOK, contain-
ing . . .

. . . terse, factual descriptions that'll
help you "spot" the catalog adver-
tisements you want to study before
deciding.

If . . . after studying these catalog
advertisements . . . you want more
information concerning prices, items
not cataloged, or data that is omit-
ted . . .

... Just mail one of these handy
reply cards . . .

... Circle the numbers that cor-
respond to the numbered
"Brief" describing the item

... or fill in the space furnished
for other product informa-
tion.

**AVOID UNNECESSARY
LETTER WRITING**

1. Send me more information on the following "Briefed" products (circle the numbers below that correspond to the numbered "Briefs" describing the products):

1	20	39	58	77	96	114	132	150	168	186	204
2	21	40	59	78	97	115	133	151	169	187	205
3	22	41	60	79	98	116	134	152	170	188	206
4	23	42	61	80	99	117	135	153	171	189	207
5	24	43	62	81	100	118	136	154	172	190	208
6	25	44	63	82	101	119	137	155	173	191	209
7	26	45	64	83	102	120	138	156	174	192	210
8	27	46	65	84	103	121	139	157	175	193	211
9	28	47	66	85	104	122	140	158	176	194	212
10	29	48	67	86	105	123	141	159	177	195	213
11	30	49	68	87	106	124	142	160	178	196	214
12	31	50	69	88	107	125	143	161	179	197	215
13	32	51	70	89	108	126	144	162	180	198	216
14	33	52	71	90	109	127	145	163	181	199	217
15	34	53	72	91	110	128	146	164	182	200	218
16	35	54	73	92	111	129	147	165	183	201	219
17	36	55	74	93	112	130	148	166	184	202	220
18	37	56	75	94	113	131	149	167	185	203	221
19	38	57	76	95							

2. Kind of information wanted _____
Send more information on the following products which are described in the catalog section

Name of Product _____ Name of Mfr. _____

Kind of information wanted _____

YOUR NAME _____ TITLE _____

COMPANY _____

ADDRESS _____ CITY _____ STATE _____

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5	24	43	62	81	100	118	136	154	172	190	208
6	25	44	63	82	101	119	137	155	173	191	209
7	26	45	64	83	102	120	138	156	174	192	210
8	27	46	65	84	103	121	139	157	175	193	211
9	28	47	66	85	104	122	140	158	176	194	212
10	29	48	67	86	105	123	141	159	177	195	213
11	30	49	68	87	106	124	142	160	178	196	214
12	31	50	69	88	107	125	143	161	179	197	215
13	32	51	70	89	108	126	144	162	180	198	216
14	33	52	71	90	109	127	145	163	181	199	217
15	34	53	72	91	110	128	146	164	182	200	218
16	35	54	73	92	111	129	147	165	183	201	219
17	36	55	74	93	112	130	148	166	184	202	220
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4	23	42	61	80	99	117	135	153	171	189	207
5	24	43	62	81	100	118	136	154	172	190	208
6	25	44	63	82	101	119	137	155	173	191	209
7	26	45	64	83	102	120	138	156	174	192	210
8	27	46	65	84	103	121	139	157	175	193	211
9	28	47	66	85	104	122	140	158	176	194	212
10	29	48	67	86	105	123	141	159	177	195	213
11	30	49	68	87	106	124	142	160	178	196	214
12	31	50	69	88	107	125	143	161	179	197	215
13	32	51	70	89	108	126	144	162	180	198	216
14	33	52	71	90	109	127	145	163	181	199	217
15	34	53	72	91	110	128	146	164	182	200	218
16	35	54	73	92	111	129	147	165	183	201	219
17	36	55	74	93	112	130	148	166	184	202	220
18	37	56	75	94	113	131	149	167	185	203	221
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Send more information on the following products which are described in the catalog section

Name of Product _____ Name of Mfr. _____

Kind of information wanted _____

YOUR NAME _____ TITLE _____

COMPANY _____

ADDRESS _____ CITY _____ STATE _____

FIRST CLASS
Permit No. 183
Chicago, Ill.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed In the United States

CERAMIC DATA BOOK
5 South Wabash Ave.
Chicago 3, Ill.



FIRST CLASS
Permit No. 183
Chicago, Ill.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed In the United States

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briefed

**FOR
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**... THIS DEPARTMENT
(Pgs. 326 to 337)**

SUMMARIZES parts of the
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ing . . .

. . . terse, factual descriptions that'll
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tisements you want to study before
deciding.

If . . . after studying these catalog
advertisements . . . you want more
information concerning prices, items
not cataloged, or data that is omit-
ted . . .

. . . Just mail one of these handy
reply cards . . .

◀ . . . Circle the numbers that cor-
respond to the numbered
"Brief" describing the item

. . . or fill in the space furnished
for other product informa-
tion.

**AVOID UNNECESSARY
LETTER WRITING**

States. Continuous production control assures uniform high quality of every shipment. Stocks are maintained for immediate shipment. Lithium content is 6%. C. Tennant Sons & Co., 100 Park Ave., New York 17, N. Y.

(Circle No. 181 on Service Coupon)

SODIUM AND POTASSIUM SILICOFLOTRIDE

—Porcelain enamellers and glass makers can rely on these chemicals for positive sources of sodium, potassium and fluorine. Products are adequately packaged for ceramic and glass consumption. Tennessee Corp., 1028 Connecticut Ave., N. W., Washington, D. C.

(Circle No. 182 on Service Coupon)

CONTINUOUS WEIGHING SYSTEMS—Thayer Scale Co. makes batching and processing scales for refractories, glass and whiteware industries. Scales are very rugged and high capacity. Automation in batch gathering and weighing is Thayer's specialty. Contact Thayer Scale Company for consultation. Thayer Scale Co., 1 Thayer Park, Pembroke, New York.

(Circle No. 183 on Service Coupon)

ZIRCONIUM OPACIFIERS—For glazes offering advantages of high opacity, increased craze resistance and elimination of pink flash, together with reduction in costs for enamels, they offer higher abrasion resistance, improved opacity, color uniformity and stability, improved lustre and finish. For specific details on a score of opacifiers, write to Titanium Alloy Mfg. Div., National Lead Co., 111 Broadway, New York, N. Y.

(Circle No. 184 on Service Coupon)

TITANIUM OPACIFIERS—Free flowing titanium dioxide for high purity and special Titanox for blue-white titania enamels have scores of advantages. They are used in enamels, glazes, colors, glass, as bodies for electrical porcelain, and pigments in colors. In fact, a complete titanium service. Data sheets are available upon request. Titanium Pigment Corp., 111 Broadway, New York 6, N. Y.

(Circle No. 185 on Service Coupon)

DRY PANS AND SEWER PIPE PRESSES—For those and other heavy clay processing machinery of rugged manufacture no matter what the problem is—handling or processing—write today for further information and catalogs to The Toronto Foundry & Machine Co., Toronto, O.

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SCREENS—Heated screens for damp clay. Hummer screen for grain size proportioning. Ty-rocket circle-throw screens for clay slip; woven wire screens and the famous Tyler standard screen scale testing sieves and Rotap testing sieve shakers. Here is complete screen service. Write for more information to The W. S. Tyler Co., 3614 Superior Ave., Cleveland 14, O.

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CLAYS—Tennessee ball clays, Georgia kaolins, South Carolina kaolins, Florida china clays, Maryland all-purpose clays are available from a single source. United Clay Mines Corporation in addition has warehouses strategically located in the East, Mid-West and Far West providing LCL distribution points for United clays, flint, feldspar, talc, sand and specialty clays. When you think of clays, think of United Clay Mines Corp., Trenton, N. J.

(Circle No. 188 on Service Coupon)

BORATES AND BORONS—Refined boron compounds are of high purity, such as borax, borax glass, boric acid and oxide. More economical sodium borate ores of lesser purity are available as Rasorite and anhydrous Rasorite. Finally, there are available borate ores for special applications, as colemanite and gerstley borate. Samples, bulletins, information and price quotations sent on request. United States Borax & Chemical Corp., 100 Park Ave., New York 17, N. Y.

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EPOXY RESIN FOR CASE MOLDS—Epoxical plastic tooling resin is a modified blue colored liquid epoxy resin. Available in several formulations as required to meet the pattern making and tooling demands of the ceramic industry for sanitary ware and dinnerware case molds. When used in conjunction with fiber glass cloth, Epoxical offers case molds that are indestructible, light weight, non efflorescent and improved working mold surfaces. For more information write United States Gypsum Co., Dept. 139, Plastic Engineering Dept., 300 W. Adams, Chicago 6, Ill.

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GRINDING MILLS FOR ALL PURPOSES—"U. S." ball mills are of extra sturdy construction. Base is welded heavy steel for rigid and smooth vibration-free operation. Sizes from ½ pint up to 117 gallons available. Burundum grinding medium wears longer and grinds faster. Write for Bulletin No. 270 on Mixing and Grinding Equipment, and No. B-25 on Burundum, U. S. Stoneware Co., Akron 9, O.

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REFRACTORY CONCRETE KILN REPAIRS—Concretes made with Lumnite cement provide savings in both installation and operation. When repairs are needed, they may be made quickly and easily, since service strengths are attained within 24 hours. Concrete may be cast in place in any size, shape or thickness. Refractory concrete service temperatures up to 2600 deg. F. available and all intermediate temperatures. Castables are convenient for both kiln repairs as well as car tops. For particulars contact Universal Atlas Cement Co., The Lumnite Div., 100 Park Ave., New York 17, N. Y.

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VIBRATING SCREENS—Rugged, dependable vibrating screens for fast, accurate separations on dry, damp, wet or sticky materials. Unilec electrically heated screens, Uniflex open or enclosed screens and Univibe vibratory riddles. Catalog No. 150 covers all models, and copies are sent free, on request. Universal Vibrating Screen Co., Deane Blvd., & St. Paul R. R., Racine, Wis.

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(Circle No. 194 on Service Coupon)

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CERAMIC REFRACTORIES—Tunnel kilns, and industrial furnaces operate better with Missouri clay refractories. Brick for pre-heat zone, hot zone, cooling zone, checkers, furnace roofs, are specifically compounded to meet varying conditions. Contact Wellsville Fire Brick Co., Wellsville, Mo. for further information.

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(Circle No. 197 on Service Coupon)

TALC FROM THE TALC HOUSE—A dependable source for over 60 years for all ceramic materials, including talc with fine grinding and blending facilities. Trial lots processed without obligation. Write for list of products and facilities to Whittaker, Clark & Daniels, Inc., Ceramics Dept. Y, 260 W. Broadway, New York 13, N. Y.

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STEEL PROCESSING BELTS—For pottery and ceramic firing, for glass annealing, for glass decorating and porcelain enamel spraying, these belts are both non-staining and heat resistant. Available in aluminized and low chrome alloys, affording low thermal capacity, complete heat circulation and minimum surface contact of open mesh construction and true running, flatness and flexibility. Complete catalogs available from: Wickwire Spencer Steel Div., The Colorado Fuel and Iron Corp., Mechanical Specialties Sales Office, Clinton, Mass.

(Circle No. 199 on Service Coupon)

NON-CLOGGING CRUSHERS—The Williams pusher-type hammer crusher will take wet clay, shale, or other sticky materials and will reduce to almost any particle size in one operation. Patented pushers force the material into the crushing zone and keep the breaker plates clean. Thirty sizes available. Also available are hammermills, mechanical air separators, fine grinding mills, impact mills and Williams dryers. Write for your catalog to Williams Patent Crusher & Pulverizer Co., 717 Montgomery St., St. Louis 6, Mo.

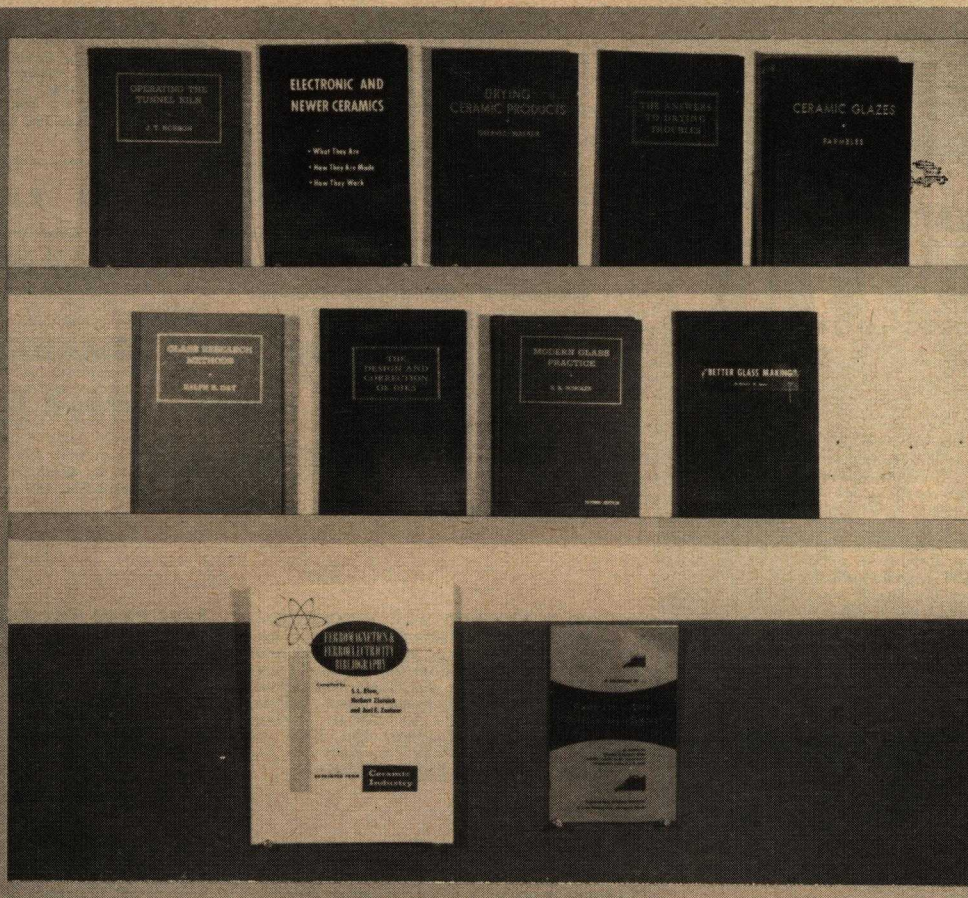
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MIXING GLASS AND CERAMIC MATERIALS—Enamel frits, glass batches, refractory batches, tile bodies, anything that must have dry mixing or just slightly moist is efficiently mixed with Worthington heavy duty mixers. Send for free bulletins. Worthington Industrial Mixer Div., Plainfield, N. J.

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1—MODERN GLASS PRACTICE—By Samuel R. Scholes—New Fourth Edition (1952) is completely revised. Old methods that are no longer practiced in the industry have been removed and supplemented by more up-to-date facts on glass production, such as atomic relations to glass, ray penetration in glass, new raw materials used in glass batches and many more. This book contains a complete treatise on glass in both technological and practical phases for the executive, practical plant man, technologist, student and general library. Describes the glassy state, elementary chemistry, glass forming oxides, glass composition, raw materials, batches and calculations, handling and mixing materials, combustion and fuels, furnaces, viscosity, melting and working glass, annealing, color and decorative processes, properties of glass, tests, defects and refractories. (312 pages, \$7.00.)

2—OPERATING THE TUNNEL KILN—By J. T. Robson—Practical "cures", handily indexed for difficulties encountered in firing dinnerware, artware, electric porcelain, sanitary ware, abrasives, stoneware, flower pots, drain tile, glazed facing tile, wall tile, quarry tile, terra cotta, building brick, hollow tile, refractories, sewer pipe. Includes charts, conversion tables and 110 illustrations, also 21 tunnel kiln firing curves. (150 pages, \$8.00.)

3—PROCELAIN ENAMEL PROCESS, DEFECTS, CAUSES AND POSSIBLE CURES—By M. E. McHardy—This book is a must for every plant and shop carrying on enameling operations. It covers all defects, including black specks, copperheads and all the others which confront enamellers, gives their causes and how they can be cured with a minimum of difficulty. Illustrations are plentiful so that defects may be identified readily. Covers defects of both zirconium and titanium enamels, as well as steel defects and production color variation. (\$0.50.)

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5—PRACTICAL ASPECTS OF CLAY PRODUCT DRYING—This reprint of 16 pages was prepared for BRICK & CLAY RECORD by J. George Seanor. It covers clay products drying and tells what's right and what's wrong with present methods and procedures. He recommends good practices—Price is 35¢.

6—THERE'S MORE TO COLOR—CERAMIC INDUSTRY offers this very fine reprint of color in the ceramic industry. It discusses the approach to the color, key note to sales, special production problems, notes from suppliers and coordination of colors in ceramic manufacturing. The reprint contains 24 pages and sells for 35¢.

7—CONDUCTIVE COATINGS FOR CERAMICS—This is written by C. Alan Lindquist, Jr., The Astatic Corporation, Conneaut, Ohio. He is an expert in this field and tells how the coatings are applied, what they are made of and what to expect in their performance. Price 50¢.

8—DRYING CERAMIC PRODUCTS—By A. F. Greaves-Walker—Fundamentals of drying, including dryer descriptions and calculations effectively presented with charts and illustrations. Contents: Evaporation; The Part Played by Air; Water Contained in Ceramic Materials; Shrinkage; The Drying Cycle; Heat Requirements; Types of Dryers; Chamber and Tunnel Dryers Heated by Steam; Fans; Selection of Fans; The Designing of Ducts or Flues; Progressive Dryers, Waste Heat Dryers in Connection with Car Tunnel Kilns; Radiated Heat Dryers; Calculations for Waste Combustion Gas Dryers; Infrared Dryers; Control of Drying; A Theoretical Method of Running a Heat Balance in a Dryer; Psychrometric Charts; and References on Drying. (\$4.00.)

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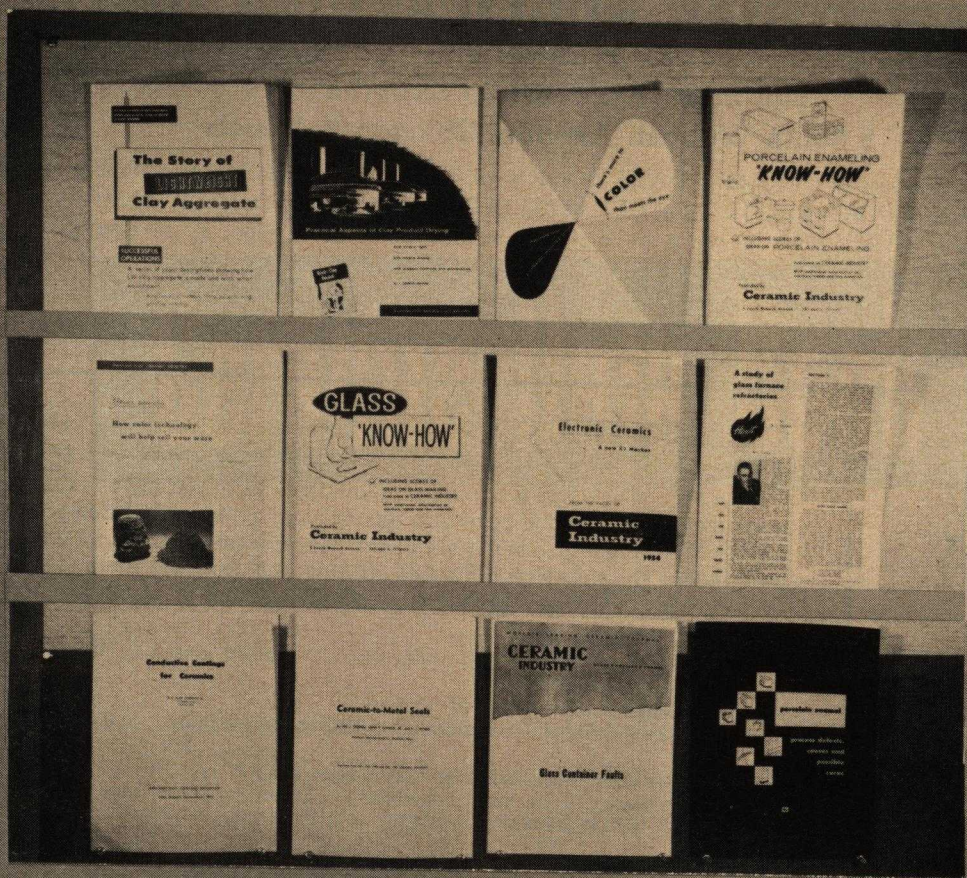
10—ELECTRONIC CERAMICS A New Ceramic Market—This is a brief pamphlet outlining some basic data on electronic ceramics. This 20-page pamphlet is an introduction to the subject. Price 25¢.

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18—GLASS CONTAINER FAULTS—This is a complete analysis of all the faults which occur in glass container manufacturing, why the faults occur and what may be done to cure the faults. This is available either in chart form for hanging on the wall or in 8½x11 pamphlet containing 24 pages. Price is \$1.

19—GLASS FURNACE REFRACTORIES—A study made by W. L. Fabianic—H. K. Porter Company. This reprint from CERAMIC INDUSTRY containing 12 pages, tells the basic needs of glass tanks and the refractories available to fit those needs. Price 25¢.

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21—GLASS PRODUCTION PROBLEM EXPERIENCES—This 24-page booklet is a reprint of the C.A.R. articles from CERAMIC INDUSTRY. C.A.R. in a very humorous way tells about the problems that confront him in manufacturing glass. Price 25¢.

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23—LIGHTWEIGHT CLAY AGGREGATE—This reprint is a 24 page compilation of articles from BRICK & CLAY RECORD which describe many successful operations in the manufacture of lightweight aggregate. It is a full study of methods, firing, pellet forming, grinding and handling clay aggregate. Price is 50¢.

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Ceramic Data Book

Editorial-Engineering Section

The reference material in CERAMIC DATA BOOK has been completely revised and further condensed this year for easy reading and fast reference.

Special attention has been paid to the need for automation and modernization of the industry. Facts that are basic to science and manufacturing are included.

The tables, charts, graphs and formulas have been gathered from thousands of references pertinent to the various branches of ceramics and gathered here under one cover.

Acknowledgement is given here to the scores of ceramic men in the industry who have aided in bringing these facts up to date. Material in this catalog is checked every year and over 100 changes were necessary this issue.

To facilitate the publishing of this edition, *page numbers* 341 to 500 inclusive have been omitted.

5 Flow of Fluids and Gases

Data for Standard Weight Pipe

Nominal Pipe Size	Diameter Inches		Thickness—In.	Threads			Circumference Inches		Transverse Area Square Inches			Length in Ft. Per Sq. Ft.		Length of Pipe Containing One Cu. Ft.	Contents in Gal. Per Lineal Foot	Weight Per Lin. Foot Lb.	Weight of Water Per Lin. Foot Lb.	Sq. Ft. of Heating Surface Per Lin. Foot
	External	Internal		Per Inch	Length of Perfect	Number of Perfect	Outside	Inside	External	Internal	Metal	External Surface	Internal Surface					
1/8	0.405	0.269	0.068	27	0.264	5.12	1.272	0.845	0.129	0.057	0.072	9.431	14.199	2533.775	0.00296	0.24	0.0247	0.106
1/4	0.540	0.364	0.088	18	0.402	5.23	1.696	1.144	0.229	0.104	0.125	7.073	10.493	1383.789	0.00540	0.42	0.0450	0.141
3/8	0.675	0.493	0.091	18	0.408	5.34	2.121	1.549	0.358	0.191	0.167	5.658	7.748	754.360	0.00992	0.57	0.0826	0.177
1/2	0.840	0.622	0.109	14	0.534	5.47	2.639	1.954	0.554	0.304	0.250	4.547	6.141	473.906	0.0158	0.85	0.132	0.220
3/4	1.050	0.824	0.113	14	0.546	5.64	3.299	2.589	0.866	0.533	0.333	3.637	4.635	270.034	0.0276	1.13	0.230	0.275
1	1.315	1.049	0.133	11 1/2	0.683	5.85	4.131	3.296	1.358	0.864	0.494	2.904	3.641	166.618	0.0449	1.68	0.374	0.344
1 1/4	1.660	1.380	0.140	11 1/2	0.707	6.13	5.215	4.335	2.164	1.495	0.669	2.301	2.768	96.275	0.0774	2.27	0.645	0.435
1 1/2	1.900	1.610	0.145	11 1/2	0.724	6.32	5.969	5.058	2.835	2.036	0.799	2.010	2.372	70.733	0.106	2.72	0.883	0.497
2	2.375	2.067	0.154	11 1/2	0.757	6.70	7.461	6.494	4.430	3.355	1.075	1.608	1.847	42.913	0.174	3.65	1.450	0.622
2 1/2	2.875	2.469	0.203	8	1.138	7.10	9.032	7.757	6.492	4.788	1.704	1.328	1.547	30.077	0.248	5.79	2.070	0.753
3	3.500	3.068	0.216	8	1.200	7.60	10.996	9.638	9.621	7.393	2.228	1.091	1.245	19.479	0.383	7.58	3.190	0.916
3 1/2	4.000	3.548	0.226	8	1.250	8.00	12.566	11.146	12.566	9.886	2.680	0.954	1.076	14.565	0.513	9.11	4.280	1.048
4	4.500	4.026	0.237	8	1.300	8.40	14.137	12.648	15.904	12.730	3.174	0.848	0.948	11.312	0.660	10.79	5.500	1.179
5	5.563	5.047	0.258	8	1.406	9.25	17.477	15.856	24.306	20.006	4.300	0.686	0.756	7.198	1.04	14.62	8.660	1.458
6	6.625	6.065	0.280	8	1.513	10.10	20.813	19.054	34.472	28.891	5.581	0.576	0.629	4.984	1.50	18.97	12.500	1.736
*7	7.625	7.023	0.301	8	1.613	10.90	23.955	22.063	45.664	38.738	6.926	0.500	0.543	3.717	2.01	23.54	16.800	1.990
*8	8.625	7.981	0.322	8	1.713	11.70	27.096	25.073	58.426	50.027	8.399	0.443	0.478	2.878	2.60	28.55	21.700	2.262
*9	9.625	8.941	0.342	8	1.813	12.50	30.238	28.089	72.760	62.786	9.974	0.396	0.427	2.294	3.26	33.91	27.200	2.515
10	10.750	10.020	0.365	8	1.925	13.40	33.772	31.479	90.763	78.855	11.908	0.355	0.381	1.826	4.10	40.48	34.200	2.817
*11	11.750	11.000	0.375	8	2.025	14.20	36.914	34.558	108.434	95.033	13.401	0.325	0.347	1.415	4.94	45.56	41.200	3.075
12	12.750	12.000	0.375	8	2.125	15.00	40.055	37.699	127.676	113.097	14.579	0.299	0.318	1.273	5.87	49.56	48.900	3.344

*These sizes are listed as standard but are not commonly used.

Courtesy, Hauck Mfg. Co., 1956

Capacities of Vertical Round Tanks

U. S. Gallons per Foot of Depth

Dia. of Tanks Ft. In.	No. U. S. Gals.	Cubic Ft. and Area in Sq. Ft.	Dia. of Tanks Ft. In.	No. U. S. Gals.	Cubic Ft. and Area in Sq. Ft.	Dia. of Tanks Ft. In.	No. U. S. Gals.	Cubic Ft. and Area in Sq. Ft.	Dia. of Tanks Ft. In.	No. U. S. Gals.	Cubic Ft. and Area in Sq. Ft.	Dia. of Tanks Ft. In.	No. U. S. Gals.	Cubic Ft. and Area in Sq. Ft.	Dia. of Tanks Ft. In.	No. U. S. Gals.	Cubic Ft. and Area in Sq. Ft.
1	5.87	.785	3 4	65.28	8.727	5 8	188.66	25.22	12	846.03	113.10	19	2120.90	283.53	26	3971.60	530.93
1 1	6.89	.922	3 5	68.58	9.168	5 9	194.25	25.97	12 3	881.65	117.86	19 3	2177.10	291.04	26 3	4048.40	541.19
1 2	8.	1.069	3 6	71.97	9.621	5 10	199.92	26.73	12 6	918.	122.72	19 6	2234.	298.65	26 6	4125.90	551.55
1 3	9.18	1.227	3 7	75.44	10.085	5 11	205.67	27.49	12 9	955.09	127.68	19 9	2291.70	306.35	26 9	4204.10	562.
1 4	10.44	1.396	3 8	78.99	10.559	6	211.51	28.27	13	992.91	132.73	20	2350.10	314.16	27	4283.	572.66
1 5	11.79	1.576	3 9	82.62	11.045	6 3	229.50	30.68	13 3	1031.50	137.89	20 3	2409.20	322.06	27 3	4362.70	583.21
1 6	13.22	1.767	3 10	86.33	11.541	6 6	248.23	33.18	13 6	1070.80	143.14	20 6	2469.10	330.06	27 6	4443.10	593.96
1 7	14.73	1.969	3 11	90.13	12.048	6 9	267.69	35.78	13 9	1110.80	148.49	20 9	2529.60	338.16	27 9	4524.30	604.81
1 8	16.32	2.182	4	94.	12.566	7	287.88	38.48	14	1151.50	153.94	21	2591.	346.36	28	4606.20	615.75
1 9	17.99	2.405	4 1	97.96	13.095	7 3	308.81	41.28	14 3	1193.	159.48	21 3	2653.	354.66	28 3	4688.80	626.80
1 10	19.75	2.640	4 2	102.	13.635	7 6	330.48	44.18	14 6	1235.30	165.13	21 6	2715.80	363.05	28 6	4772.10	637.94
1 11	21.58	2.885	4 3	106.12	14.186	7 9	352.88	47.17	14 9	1278.20	170.87	21 9	2779.30	371.54	28 9	4856.20	649.18
2	23.50	3.142	4 4	110.32	14.748	8	376.01	50.27	15	1321.90	176.71	22	2843.60	380.13	29	4941.	660.52
2 1	25.50	3.409	4 5	114.61	15.321	8 3	399.88	53.46	15 3	1366.40	182.65	22 3	2908.60	388.82	29 3	5026.60	671.96
2 2	27.58	3.687	4 6	118.97	15.90	8 6	424.48	56.75	15 6	1411.50	188.69	22 6	2974.30	397.61	29 6	5112.90	683.49
2 3	29.74	3.976	4 7	123.42	16.50	8 9	449.82	60.13	15 9	1457.40	194.83	22 9	3040.80	406.49	29 9	5199.90	695.13
2 4	31.99	4.276	4 8	127.95	17.10	9	475.89	63.62	16	1504.10	201.06	23	3108.	415.48	30	5287.70	706.86
2 5	34.31	4.587	4 9	132.56	17.72	9 3	502.70	67.20	16 3	1551.40	207.39	23 3	3175.90	424.56	30 3	5376.20	718.69
2 6	36.72	4.909	4 10	137.25	18.35	9 6	530.24	70.88	16 6	1599.50	213.82	23 6	3244.60	433.74	30 6	5465.40	730.62
2 7	39.21	5.241	4 11	142.02	18.99	9 9	558.51	74.66	16 9	1648.40	220.65	23 9	3314.	443.01	30 9	5555.40	742.64
2 8	41.78	5.585	5	146.88	19.63	10	587.52	78.54	17	1697.90	226.98	24	3384.10	452.39	31	5646.10	754.77
2 9	44.43	5.940	5 1	151.82	20.29	10 3	617.26	82.52	17 3	1748.20	233.71	24 3	3455.	461.86	31 3	5737.50	766.99
2 10	47.16	6.305	5 2	156.83	20.97	10 6	640.74	86.69	17 6	1799.30	240.53	24 6	3526.60	471.44	31 6	5829.70	779.31
2 11	49.98	6.681	5 3	161.93	21.65	10 9	678.95	90.76	17 9	1851.10	247.45	24 9	3598.90	481.11	31 9	5922.60	791.73
3	52.88	7.069	5 4	167.12	22.34	11	710.90	95.03	18	1903.60	254.47	25	3672.	490.87	32	6016.20	804.25
3 1	55.86	7.467	5 5	172.38	23.04	11 3	743.58	99.40	18 3	1956.80	261.59	25 3	3745.80	500.74	32 3	6110.60	816.86
3 2	58.92	7.876	5 6	177.72	23.76	11 6	776.99	103.87	18 6	2010.80	268.80	25 6	3820.30	510.71	32 6	6205.70	829.58
3 3	62.06	8.296	5 7	183.15	24.48	11 9	811.14	108.43	18 9	2065.50	276.12	25 9	3895.60	520.77	32 9	6301.50	842.39

NOTE: To find the capacity of tanks greater than the largest given in the table, look in the table for a tank of one-half of the given size and multiply its capacity by 4, or one of one-third its size and multiply its capacity by 9, etc.

Courtesy, Hauck Mfg. Co., 1956

Piping Pressure Losses for 100 SSU Oil, in psi per 100 feet of Standard Pipe

Oil flow in gph	Nominal pipe size in inches				
	1/2	3/4	1	1 1/4	1 1/2
100	5.90	1.92	0.73	0.28	0.15
200	11.80	3.84	1.46	0.56	0.30
300	17.70	5.76	2.19	0.84	0.45
400	23.60	7.68	2.92	1.12	0.60
500	29.50	9.60	3.65	1.40	0.75
600	35.40	11.52	4.38	1.68	0.90
700	88.6	22.6	5.11	1.96	1.05
800	169.3	43.3	5.84	2.24	1.20
900	...	150.7	6.57	2.52	1.35
1000	...	...	13.3	2.76	1.49
2000	...	...	46.8	12.4	5.83
3000	...	...	94.0	25.8	12.1

Note: This table is for a typical oil of 100 SSU viscosity and should therefore be considered as only approximate. This viscosity is the desired value for low pressure air atomization.

Courtesy, North American Mfg. Co., 1956

Piping Pressure Losses for 500 SSU Oil, in psi per 100 feet of Standard Pipe

Oil flow in gph	Nominal pipe size in inches				
	1/2	3/4	1	1 1/4	1 1/2
100	32.1	10.4	3.97	1.32	0.71
200	64.2	20.8	7.94	2.64	1.43
300	96.3	31.3	11.9	3.97	2.14
400	128.4	41.7	15.9	5.29	2.86
500	160.5	52.1	19.9	6.61	3.57
600	...	62.5	23.8	7.93	4.29
700	...	73.0	27.8	9.26	5.00
800	...	83.4	31.8	10.6	5.71
900	...	93.8	35.7	11.9	6.43
1000	...	104.2	39.7	13.2	7.15
2000	...	...	79.4	26.4	14.3
3000	...	...	119.1	39.7	21.4

Note: This table is for a typical oil of 500 SSU viscosity and should therefore be considered as only approximate. This viscosity is a desirable value for pumping oil although viscosities as high as 10,000 are in use.

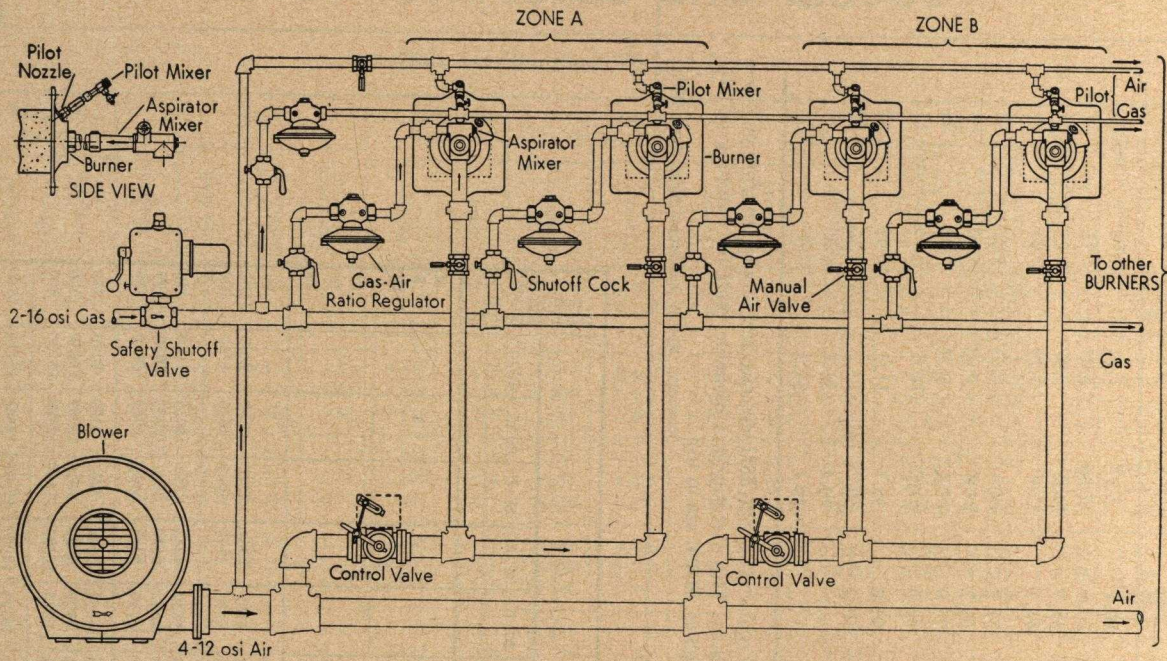
Courtesy, North American Mfg. Co., 1956

Capacity of Horizontal Tanks—Gallons

Nominal Inside Dia.	LENGTH OF TANK																			Additional Gals. for 2 Disks Heads
	2'-0"	3'-0"	4'-0"	5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	11'-0"	13'-0"	15'-0"	17'-8"	20'-8"	23'-8"	27'-6"	31'-6"	34'-4"	39'-4"	40'-0"	
							G	A	L	L	O	N	S							
12"	12	18	24	28	35	41	47												4	
15"	18	27	36	45	54	64	73												8	
18"	27	40	53	66	79	93	106												10	
24"	47	71	94	118	141	165	188												12	
30"	73	110	146	183	220	257	294	360	434	478	551	649	759	869					14	
36"	106	159	212	264	317	370	423	520	626	732	838	934	1093	1252					28	
42"	144	216	288	360	432	504	576	707	851	995	1139	1272	1488	1704					50	
48"	188	282	376	470	564	658	752	914	1102	1290	1478	1660	1942	2224	2585	2961	3227	3697	85	
54"	238	357	476	595	714	833	952	1170	1408	1646	1884	2102	2459	2816	3272	3748	4085	4680	100	
56"	256	384	512	640	768	896	1024	1258	1514	1770	2026	2261	2645	3029	3520	4032	4395	5035	110	
60"	294	441	588	735	882	1029	1176	1445	1739	2033	2327	2597	3038	3479	4042	4630	5047	5782	140	
65"	344	516	688	860	1032	1204	1376	1690	2034	2378	2722	3039	3555	4071	4730	5418	5905	6765	190	
72"	422	633	822	1055	1266	1477	1688	2074	2496	2918	3340	3740	4361	4994	5802	6624	7244	8299	218	
84"	574	861	1148	1435	1722	2009	2296	2821	3395	3682	4557	5071	5932	6793	7892	9040	9854	11289	350	
90"	660	990	1320	1650	1980	2310	2640	3244	3904	4564	5224	5831	6821	7811	9075	10395	11330	12980	400	
96"	756	1134	1512	1890	2268	2646	3024	3715	4471	5227	5983	6679	7813	8947	10395	11907	12978	14868	500	
108"	950	1425	1900	2375	2850	3325	3800	4669	5619	6569	7519	8393	9818	11243	13062	14962	16308	18683	675	
120"	1175	1762	2350	2937	3525	4112	4700	5775	6950	8125	9300	10381	12143	13905	16156	18506	20170	23107	23500	925
126"	1295	1942	2590	3237	3885	4532	5180	6365	7660	8955	10250	11441	13383	15325	17806	20396	22230	25467	1006	

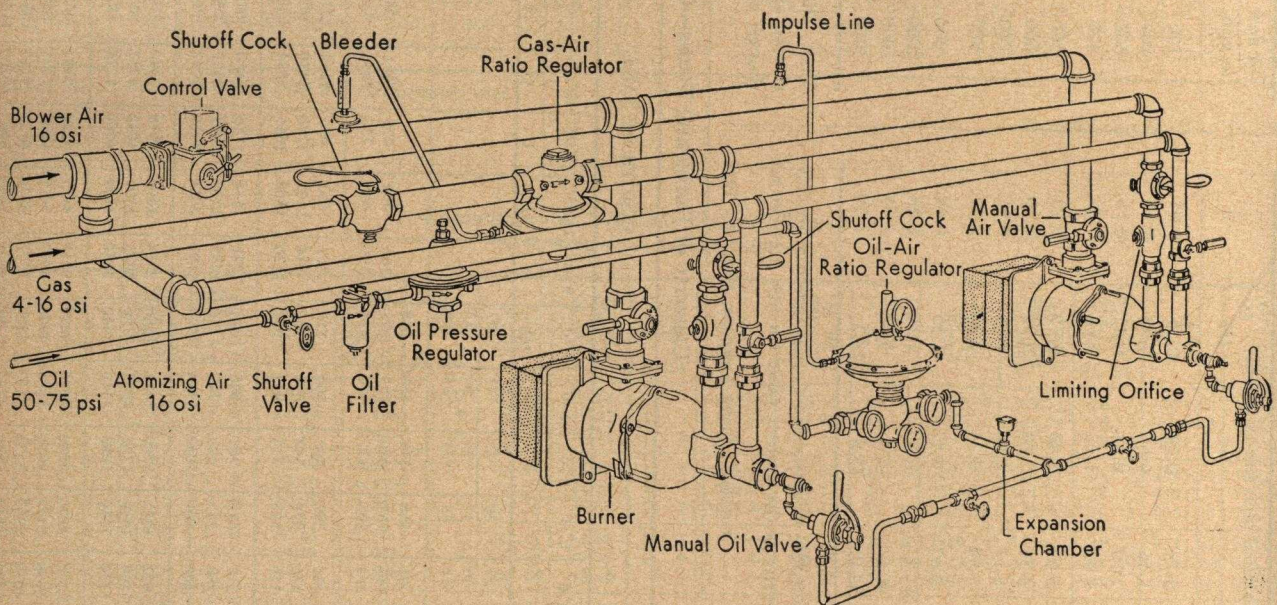
Courtesy,
Hauck Mfg. Co., 1956

Piping Arrangement for Premixing Gas Burners



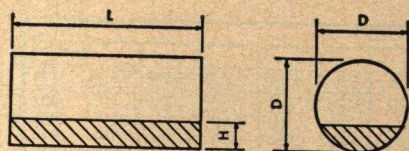
Courtesy, North American Mfg. Co., 1956

Piping Arrangement for Combination Burners for Gas and Light Oil



Courtesy, North American Mfg. Co., 1956

Partial Volumes in Horizontal Cylinders



For computing quantity of oil in horizontal cylindrical tanks.

Partial volume in height (H) = Cylindrical coefficient for H/D × total volume.

$$\text{Total volume} = \frac{\pi L D^2}{4}$$

H/D	L = LENGTH OF CYLINDER									
	0	1	2	3	4	5	6	7	8	9
	COEFFICIENTS FOR PARTIAL VOLUMES OF HORIZONTAL CYLINDERS									
.00	.000000	.000053	.000151	.000279	.000429	.000600	.000788	.000992	.001212	.001445
.01	.001692	.001952	.002223	.002507	.002800	.003104	.003419	.003743	.004077	.004421
.02	.004773	.005134	.005503	.005881	.006267	.006660	.007061	.007470	.007886	.008310
.03	.008742	.009179	.009625	.010076	.010534	.010999	.011470	.011947	.012432	.012920
.04	.013417	.013919	.014427	.014940	.015459	.015985	.016515	.017052	.017593	.018141
.05	.018692	.019250	.019813	.020382	.020955	.021533	.022115	.022703	.023296	.023894
.06	.024496	.025103	.025715	.026331	.026952	.027578	.028208	.028842	.029481	.030124
.07	.030772	.031424	.032081	.032740	.033405	.034073	.034747	.035423	.036104	.036789
.08	.037478	.038171	.038867	.039569	.040273	.040981	.041694	.042410	.043129	.043852
.09	.044579	.045310	.046043	.046782	.047523	.048268	.049017	.049768	.050524	.051283
.10	.052044	.052810	.053579	.054351	.055126	.055905	.056688	.057474	.058262	.059054
.11	.059850	.060648	.061449	.062253	.063062	.063872	.064687	.065503	.066323	.067147
.12	.067972	.068802	.069633	.070469	.071307	.072147	.072991	.073836	.074686	.075539
.13	.076393	.077251	.078112	.078975	.079841	.080709	.081581	.082456	.083332	.084212
.14	.085094	.085979	.086866	.087756	.088650	.089545	.090443	.091343	.092246	.093153
.15	.094061	.094971	.095884	.096799	.097717	.098638	.099560	.100486	.101414	.102343
.16	.103275	.104211	.105147	.106087	.107029	.107973	.108920	.109869	.110820	.111773
.17	.112728	.113686	.114646	.115607	.116572	.117538	.118506	.119477	.120450	.121425
.18	.122403	.123382	.124364	.125347	.126333	.127321	.128310	.129302	.130296	.131292
.19	.132290	.133291	.134292	.135296	.136302	.137310	.138320	.139332	.140345	.141361
.20	.142378	.143398	.144419	.145443	.146468	.147494	.148524	.149554	.150587	.151622
.21	.152659	.153697	.154737	.155779	.156822	.157867	.158915	.159963	.161013	.162066
.22	.163120	.164176	.165233	.166292	.167353	.168416	.169480	.170546	.171613	.172682
.23	.173753	.174825	.175900	.176976	.178053	.179131	.180212	.181294	.182378	.183463
.24	.184550	.185639	.186729	.187820	.188912	.190007	.191102	.192200	.193299	.194400
.25	.195501	.196604	.197709	.198814	.199922	.201031	.202141	.203253	.204368	.205483
.26	.206600	.207718	.208837	.209957	.211079	.212202	.213326	.214453	.215580	.216708
.27	.217839	.218970	.220102	.221235	.222371	.223507	.224645	.225783	.226924	.228065
.28	.229209	.230352	.231498	.232644	.233791	.234941	.236091	.237242	.238395	.239548
.29	.240703	.241859	.243016	.244173	.245333	.246494	.247655	.248819	.249983	.251148
.30	.252315	.253483	.254652	.255822	.256992	.258165	.259338	.260512	.261687	.262863
.31	.264039	.265218	.266397	.267578	.268760	.269942	.271126	.272310	.273495	.274682
.32	.275869	.277058	.278247	.279437	.280627	.281820	.283013	.284207	.285401	.286598
.33	.287795	.288992	.290191	.291390	.292591	.293793	.294995	.296198	.297403	.298605
.34	.299814	.301021	.302228	.303438	.304646	.305857	.307068	.308280	.309492	.310705
.35	.311918	.313134	.314350	.315566	.316783	.318001	.319219	.320439	.321660	.322881
.36	.324104	.325326	.326550	.327774	.328999	.330225	.331451	.332678	.333905	.335134
.37	.336363	.337593	.338823	.340054	.341286	.342519	.343751	.344985	.346220	.347455
.38	.348690	.349926	.351164	.352402	.353640	.354879	.356119	.357359	.358599	.359840
.39	.361082	.362325	.363568	.364811	.366056	.367300	.368545	.369790	.371036	.372282
.40	.373530	.374778	.376026	.377275	.378524	.379774	.381024	.382274	.383526	.384778
.41	.386030	.387283	.388537	.389790	.391044	.392298	.393553	.394808	.396063	.397320
.42	.398577	.399834	.401092	.402350	.403608	.404866	.406125	.407384	.408645	.409904
.43	.411165	.412426	.413687	.414949	.416211	.417473	.418736	.419998	.421261	.422525
.44	.423788	.425052	.426316	.427582	.428846	.430112	.431378	.432645	.433911	.435178
.45	.436445	.437712	.438979	.440246	.441514	.442782	.444050	.445318	.446587	.447857
.46	.449125	.450394	.451663	.452932	.454201	.455472	.456741	.458012	.459283	.460554
.47	.461825	.463096	.464367	.465638	.466910	.468182	.469453	.470725	.471997	.473269
.48	.474541	.475814	.477086	.478358	.479631	.480903	.482176	.483449	.484722	.485995
.49	.487269	.488542	.489814	.491087	.492360	.493633	.494906	.496179	.497452	.498726
.50	.500000	.501274	.502548	.503821	.505094	.506367	.507640	.508913	.510186	.511458

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When the tank is more than 50% full, the amount of oil it contains is determined by calculating the unfilled portion and subtracting it from the total tank capacity.

Courtesy, Hauck Mfg. Co., 1956

Pressure Loss by Friction of Air in Pipes

Pressures in Ounces per Square Inch Lost by Friction of Air in Pipes of 100 Feet Long

Velocity in F.P.M.	Diameter of Pipes — Inches													
	1		1 1/4		1 1/2		2		2 1/2		3		4	
	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss
100	.54	.011	.85	.010	1.23	.009	2.2	.006	3.41	.005	5	.004	9	.003
200	1.09	.044	1.70	.039	2.45	.033	4.4	.022	6.82	.019	10	.015	17	.011
300	1.64	.100	2.55	.088	3.68	.075	6.5	.050	10.23	.042	15	.033	26	.025
400	2.18	.178	3.40	.155	4.90	.132	8.7	.088	13.65	.073	20	.059	35	.044
500	2.73	.278	4.26	.243	6.13	.208	10.9	.139	17.06	.115	25	.092	44	.069
600	3.27	.400	5.11	.350	7.36	.300	13.0	.200	20.46	.166	29	.133	52	.100
700	3.82	.544	5.96	.476	8.58	.408	15.3	.272	23.86	.226	34	.181	61	.139
800	4.36	.711	6.81	.622	9.81	.534	17.4	.356	27.30	.296	39	.237	70	.178
900	4.90	.900	7.66	.788	11.04	.675	19.6	.450	30.70	.375	44	.300	78	.225
1000	5.45	1.111	8.51	.972	12.27	.834	21.8	.556	34.10	.463	49	.370	87	.278
1100	6.00	1.344	9.36	1.176	13.50	1.008	24.0	.672	37.52	.560	54	.448	96	.338
1200	6.54	1.600	10.21	1.400	14.71	1.200	26.2	.800	40.90	.666	59	.533	105	.400
1300	7.09	1.878	11.07	1.643	15.95	1.408	28.4	.939	44.30	.782	64	.626	113	.469
1400	7.63	2.178	11.93	1.905	17.18	1.633	30.5	1.089	47.75	.907	69	.726	122	.544
1500	8.18	2.500	12.78	2.187	18.40	1.875	32.7	1.250	51.18	1.041	74	.833	131	.625
1600	8.72	2.844	13.63	2.489	19.62	2.133	35.0	1.422	54.55	1.185	78	.948	140	.711
1700	9.27	3.211	14.48	2.809	20.85	2.407	37.1	1.605	58.00	1.337	83	1.070	148	.803
1800	9.82	3.600	15.33	3.150	22.08	2.700	39.3	1.800	61.35	1.500	88	1.200	157	.900
1900	10.36	4.011	16.18	3.510	23.30	3.009	41.5	2.006	64.77	1.671	93	1.337	166	1.003
2000	10.90	4.444	17.03	3.888	24.54	3.333	43.6	2.222	68.20	1.851	98	1.481	175	1.111
2200	12.00	5.378	18.73	4.705	27.00	4.033	48.0	2.689	75.00	2.241	108	1.793	192	1.344
2400	13.10	6.400	20.42	5.600	29.42	4.800	52.0	3.200	81.80	2.667	118	2.133	209	1.600
2600	14.20	7.511	22.15	6.572	31.90	5.634	57.0	3.756	88.60	3.130	128	2.504	227	1.877
2800	15.30	8.711	23.82	7.622	34.35	6.534	61.0	4.356	95.50	3.630	137	2.904	244	2.178
3000	16.40	10.000	25.55	8.750	36.81	7.500	65.0	5.000	104.30	4.166	147	3.333	262	2.500
3200	17.40	11.378	27.25	9.955	39.23	8.533	70.0	5.689	109.10	4.740	157	3.792	279	2.844
3400	18.50	12.844	28.97	11.239	41.70	9.633	74.0	6.422	116.00	5.351	167	4.281	297	3.211
3600	19.60	14.400	30.65	12.600	44.20	10.800	78.0	7.200	122.80	6.000	177	4.800	314	3.600
3800	20.70	16.044	32.38	14.038	46.60	12.033	83.0	8.022	129.60	6.685	186	5.349	332	4.011
4000	21.80	17.778	34.07	15.555	49.00	13.333	87.0	8.889	136.50	7.407	196	5.926	350	4.444
4200							92.0	9.800	143.20	8.176	206	6.553	367	4.900
4400							96.0	10.705	150.00	8.940	216	7.175	384	5.353
4600							105.0	12.800	163.70	10.666	236	8.533	419	6.400
4800							113.0	15.022	177.30	12.518	255	10.015	454	7.511
5000							122.0	17.422	191.00	14.518	275	11.615	489	8.711
5200							131.0	20.000	204.60	16.666	295	13.333	524	10.000
5400														
5600														
5800														
6000														

Velocity in F.P.M.	Diameter of Pipes — Inches													
	8		9		10		12		14		16		18	
	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss	C.F.M.	Loss
100	35	.001	44	.001	54	.001	78	.001	107	.001	140	.001	177	.001
200	70	.006	88	.005	109	.004	157	.004	214	.003	279	.003	353	.002
300	105	.012	132	.011	164	.010	235	.008	321	.007	419	.006	530	.005
400	140	.022	177	.020	218	.018	314	.015	428	.013	558	.011	707	.010
500	175	.035	221	.031	273	.028	393	.023	534	.020	698	.017	883	.016
600	209	.050	265	.044	327	.040	471	.033	641	.029	838	.025	1060	.022
700	244	.068	309	.060	382	.054	550	.045	748	.039	977	.034	1237	.030
800	279	.089	353	.079	436	.071	628	.059	855	.051	1117	.044	1414	.040
900	314	.112	398	.100	490	.090	707	.075	962	.064	1256	.056	1590	.050
1000	349	.139	442	.123	545	.111	785	.092	1069	.079	1396	.069	1767	.062
1100	384	.168	486	.149	600	.134	864	.112	1176	.096	1536	.084	1944	.075
1200	419	.200	530	.179	654	.160	942	.133	1283	.114	1675	.100	2120	.089
1300	454	.235	574	.209	709	.188	1021	.156	1390	.134	1815	.117	2297	.104
1400	489	.282	618	.242	763	.218	1100	.181	1497	.156	1954	.136	2474	.121
1500	523	.312	662	.278	818	.250	1178	.208	1603	.179	2094	.156	2650	.139
1600	558	.356	707	.316	872	.284	1256	.237	1710	.203	2234	.178	2827	.158
1700	593	.401	750	.357	927	.321	1335	.268	1817	.229	2373	.207	3004	.178
1800	628	.450	795	.400	982	.360	1413	.300	1924	.257	2513	.225	3181	.200
1900	663	.501	839	.446	1036	.401	1492	.334	2031	.287	2652	.251	3357	.223
2000	698	.556	883	.493	1090	.444	1570	.370	2138	.317	2792	.278	3534	.247
2200	768	.672	971	.597	1200	.538	1728	.448	2352	.384	3071	.336	3887	.299
2400	838	.800	1060	.711	1310	.640	1885	.533	2566	.457	3350	.400	4241	.356
2600	907	.939	1148	.835	1420	.751	2042	.626	2779	.537	3630	.468	4594	.417
2800	977	1.089	1237	.968	1530	.871	2199	.726	2993	.622	3909	.544	4948	.484
3000	1047	1.250	1325	1.111	1640	1.000	2356	.833	3207	.714	4188	.625	5301	.566
3200	1117	1.422	1413	1.263	1740	1.138	2513	.948	3421	.813	4467	.711	5654	.632
3400	1187	1.606	1502	1.427	1850	1.284	2660	1.070	3635	.917	4746	.827	6008	.714
3600	1256	1.800	1590	1.600	1960	1.440	2827	1.200	3848	1.029	5026	.900	6361	.800
3800	1326	2.006	1678	1.783	2070	1.604	2984	1.337	4062	1.146	5305	1.003	6715	.891
4000	1396	2.222	1767	1.975	2180	1.778	3146	1.481	4276	1.270	5584	1.111	7068	.988
4200	1466	2.450	1855	2.178	2290	1.960	3299	1.633	4490	1.400	5863	1.225	7421	1.089
4400	1536	2.676	1943	2.379	2399	2.141	3455	1.784	4704	1.537	6142	1.344	7775	1.189
4600	1605	2.900	2030	2.584	2507	2.333	3611	1.939	4918	1.674	6423	1.477	8087	1.299
4800	1675	3.125	2117	2.797	2615	2.525	3767	2.090	5132	1.811	6701	1.600	8401	1.422
5000	1745	3.350	2204	3.000	2723	2.717	3923	2.241	5346	1.944	6915	1.722	8615	1.544
5200	1815	3.575	2292	3.204	2831	2.900	4079	2.392	5560	2.077	7129	1.844	8829	1.666
5400	1885	3.800	2380	3.408	2939	3.092	4235	2.543	5774	2.200	7343	1.966	9043	1.788
5600	1954	4.025	2468	3.612	3047	3.284	4391	2.694	5988	2.322	7557	2.088	9257	1.910
5800	2024	4.250	2556	3.816	3155	3.476	4547	2.845	6202	2.444	7771	2.200	9471	2.032
6000	2094	4.475	2643	4.019	3263	3.668	4703	3.000	6416	2.566	7985	2.322	9685	2.154

Prepared by Spencer Turbine Co.

Courtesy, Hauck Mfg. Co., 1956

Flow Capacity Multiplier Table

Pressure in Any Units Of Known Capacity	MULTIPLY KNOWN CAPACITY BY FACTOR BELOW UNDER DESIRED PRESSURE TO DETERMINE NEW CAPACITY															
	1/2	1	2	3	4	5	6	7	8	9	10	11	12	13	13.6	14
1/2	1.0	1.41	2.00	2.46	2.83	3.16	3.45	3.79	4.00	4.25	4.48	4.69	4.90	5.10	5.21	5.30
1	.710	1.00	1.41	1.73	2.00	2.24	2.45	2.65	2.83	3.00	3.17	3.32	3.43	3.61	3.68	3.74
2	.500	.710	1.00	1.25	1.41	1.58	1.73	1.87	2.00	2.12	2.24	2.35	2.45	2.55	2.61	2.65
3	.408	.578	.82	1.00	1.15	1.29	1.41	1.53	1.63	1.73	1.83	1.91	2.00	2.08	2.13	2.16
4	.354	.500	.709	.86	1.00	1.12	1.23	1.32	1.41	1.50	1.58	1.66	1.73	1.80	1.84	1.87
5	.316	.447	.631	.775	.895	1.00	1.09	1.18	1.26	1.34	1.41	1.48	1.55	1.61	1.65	1.67
6	.288	.408	.578	.706	.815	.912	1.00	1.08	1.15	1.22	1.29	1.35	1.41	1.47	1.50	1.53
7	.268	.378	.535	.655	.755	.845	.925	1.00	1.07	1.13	1.19	1.25	1.31	1.36	1.39	1.41
8	.250	.353	.500	.613	.717	.790	.865	.935	1.00	1.06	1.12	1.17	1.22	1.27	1.30	1.32
9	.236	.334	.471	.577	.666	.745	.817	.880	.940	1.00	1.05	1.10	1.15	1.20	1.23	1.25
10	.224	.316	.447	.548	.632	.709	.775	.836	.895	.95	1.00	1.05	1.09	1.14	1.17	1.18
11	.213	.302	.426	.521	.602	.675	.739	.798	.854	.905	.95	1.00	1.04	1.09	1.11	1.13
12	.204	.289	.409	.500	.578	.645	.706	.764	.818	.865	.912	.956	1.00	1.04	1.06	1.08
13	.196	.277	.392	.480	.554	.620	.680	.734	.785	.832	.885	.920	.96	1.00	1.02	1.04
13.6	.192	.272	.383	.469	.544	.606	.666	.720	.769	.813	.855	.900	.944	.980	1.00	1.02
14	.189	.267	.378	.462	.535	.598	.655	.706	.755	.800	.845	.885	.925	.965	.985	1.00
15	.183	.268	.365	.447	.515	.578	.633	.683	.73	.775	.815	.855	.895	.930	.952	.965
16	.178	.250	.354	.433	.500	.560	.612	.662	.706	.750	.790	.830	.865	.901	.922	.935
17	.171	.243	.343	.420	.485	.542	.594	.642	.686	.729	.767	.804	.840	.875	.894	.910
18	.167	.236	.334	.409	.471	.527	.578	.625	.667	.706	.745	.782	.815	.85	.869	.892
19	.162	.230	.325	.398	.459	.513	.562	.607	.650	.689	.725	.760	.795	.829	.846	.860
20	.158	.224	.316	.388	.446	.500	.548	.593	.632	.670	.706	.741	.775	.806	.825	.835
21	.154	.218	.309	.378	.436	.488	.535	.578	.617	.655	.690	.723	.755	.786	.805	.816
22	.151	.214	.302	.370	.426	.476	.523	.564	.603	.640	.675	.706	.739	.770	.786	.797
23	.1475	.209	.295	.361	.417	.466	.511	.551	.590	.625	.660	.691	.721	.752	.769	.780
24	.144	.204	.289	.354	.408	.456	.500	.540	.578	.612	.645	.678	.706	.735	.753	.764
25	.141	.20	.283	.346	.400	.467	.490	.530	.565	.600	.631	.664	.693	.721	.738	.748
27.7	.135	.19	.27	.33	.38	.43	.47	.50	.54	.57	.60	.63	.66	.68	.70	.71
30	.129	.183	.268	.316	.365	.409	.446	.484	.517	.548	.578	.605	.632	.659	.673	.684
35	.1195	.169	.239	.293	.348	.378	.414	.447	.479	.507	.535	.560	.585	.610	.623	.632

Pressure in Any Units Of Known Capacity	MULTIPLY KNOWN CAPACITY BY FACTOR BELOW UNDER DESIRED PRESSURE TO DETERMINE NEW CAPACITY													
	15	16	17	18	19	20	21	22	23	24	25	27.7	30	35
1/2	5.48	5.65	5.83	6.0	6.15	6.33	6.47	6.65	6.80	6.93	7.05	7.43	7.75	8.36
1	3.88	4.0	4.12	4.25	4.36	4.47	4.58	4.69	4.80	4.90	5.00	5.26	5.48	5.91
2	2.74	2.83	2.92	3.0	3.08	3.16	3.24	3.32	3.39	3.46	3.54	3.71	3.88	4.18
3	2.24	2.31	2.38	2.45	2.52	2.58	2.65	2.70	2.77	2.83	2.88	3.03	3.16	3.42
4	1.935	2.00	2.06	2.12	2.18	2.24	2.29	2.34	2.40	2.45	2.50	2.62	2.74	2.96
5	1.731	1.79	1.84	1.89	1.95	2.00	2.04	2.10	2.14	2.19	2.24	2.35	2.45	2.54
6	1.58	1.63	1.68	1.73	1.78	1.83	1.87	1.92	1.96	2.00	2.04	2.14	2.24	2.42
7	1.46	1.51	1.56	1.60	1.645	1.69	1.73	1.77	1.81	1.85	1.89	1.98	2.17	2.24
8	1.37	1.41	1.44	1.50	1.54	1.58	1.62	1.66	1.69	1.73	1.77	1.85	1.94	2.09
9	1.29	1.33	1.37	1.41	1.45	1.49	1.53	1.56	1.60	1.63	1.67	1.75	1.82	1.97
10	1.225	1.265	1.30	1.34	1.38	1.41	1.45	1.48	1.51	1.55	1.58	1.66	1.73	1.87
11	1.170	1.205	1.24	1.28	1.31	1.35	1.38	1.41	1.45	1.475	1.51	1.58	1.65	1.78
12	1.120	1.153	1.19	1.22	1.26	1.29	1.32	1.36	1.38	1.41	1.44	1.51	1.58	1.71
13	1.075	1.11	1.14	1.175	1.21	1.24	1.27	1.30	1.32	1.36	1.39	1.46	1.52	1.64
13.6	1.05	1.09	1.12	1.15	1.18	1.21	1.24	1.27	1.30	1.33	1.36	1.43	1.49	1.61
14	1.036	1.07	1.10	1.135	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.40	1.46	1.58
15	1.00	1.03	1.065	1.095	1.125	1.155	1.182	1.211	1.24	1.265	1.29	1.35	1.41	1.53
16	.97	1.00	1.03	1.060	1.08	1.120	1.145	1.172	1.20	1.225	1.25	1.31	1.37	1.48
17	.94	.97	1.00	1.030	1.055	1.082	1.11	1.14	1.162	1.19	1.212	1.27	1.33	1.435
18	.914	.945	.974	1.00	1.027	1.051	1.08	1.107	1.130	1.155	1.18	1.24	1.29	1.391
19	.89	.92	.945	.974	1.00	1.025	1.05	1.076	1.100	1.125	1.148	1.20	1.255	1.36
20	.875	.895	.921	.940	.975	1.00	1.025	1.05	1.072	1.093	1.12	1.17	1.225	1.32
21	.845	.875	.900	.926	.950	.975	1.00	1.02	1.046	1.07	1.08	1.14	1.192	1.29
22	.825	.854	.880	.905	.930	.954	.978	1.00	1.021	1.041	1.068	1.12	1.17	1.26
23	.807	.835	.860	.885	.910	.932	.955	.980	1.00	1.021	1.048	1.09	1.14	1.235
24	.79	.815	.841	.866	.890	.914	.935	.96	.98	1.00	1.02	1.07	1.12	1.21
25	.775	.800	.825	.850	.881	.895	.915	.938	.96	.98	1.00	1.05	1.093	1.185
27.7	.74	.76	.79	.81	.83	.85	.88	.89	.92	.93	.95	1.00	1.06	1.12
30	.707	.730	.754	.785	.795	.816	.836	.856	.875	.895	.917	.94	1.00	1.07
35	.654	.676	.696	.718	.736	.755	.784	.794	.810	.829	.845	.89	.925	1.00

Example: If a burner has a known or calculated capacity of 500 cu. ft. per hour at 6" water pressure it will have at 10" water pressure $1.29 \times 500 = 645$ cu. ft. per hour capacity. The multiplier 1.29 is located below the "10" column in the "6" line.
If the capacity is 500 cu. ft. per hour at 10" water pressure it will be $500 \times .775 = 387$ cu. ft. per hour at 6" water pressure. The multiplier .775 is located in the "6" column in the "10" line.

Multipliers can be used for any units of pressure and the result will always be in the same units.

Conversion factors for flow values corresponding to inches of water, inches of mercury and lbs. per sq. in., can be found by using columns and rows marked 1, 13.6 and 27.7, respectively. Example: the flow value for 7 in. water pressure is known and the flow value for 3 in. of mercury pressure is required. First, find the flow for 1 in. mercury pressure by multiplying the known flow by 1.39. The multiplier 1.39 is located in the "13.6" column on the "7" line. The flow at 3 in. mercury pressure is then found by multiplying the flow just determined by 1.73, found at the intersection of column "3" and row "1".

13.6 in. water = 1 in. mercury

27.7 in. water = 1 lb. per sq. in.

2.0 in. mercury = 1 lb. per sq. in.

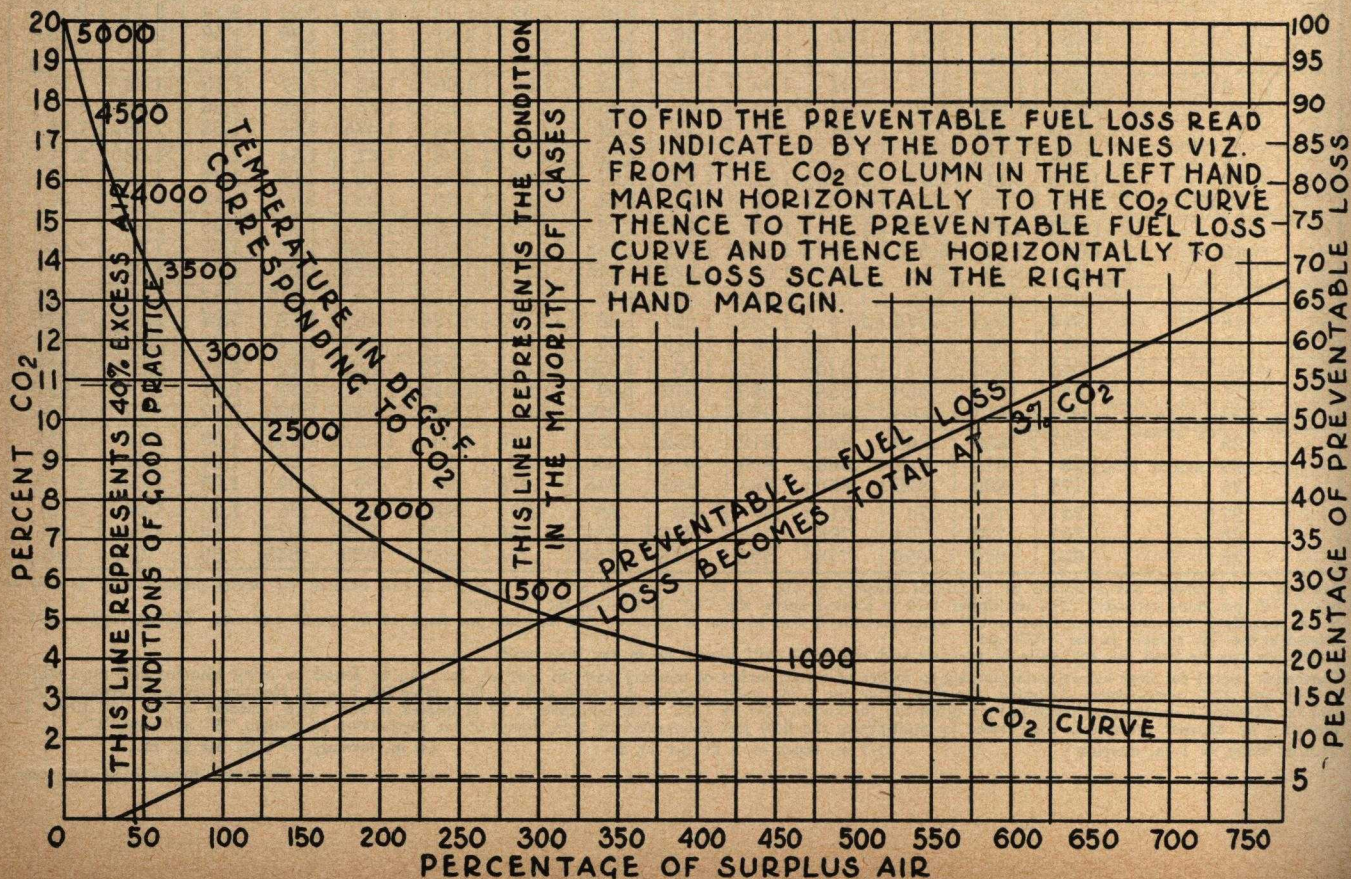
6

Fuels, Combustion

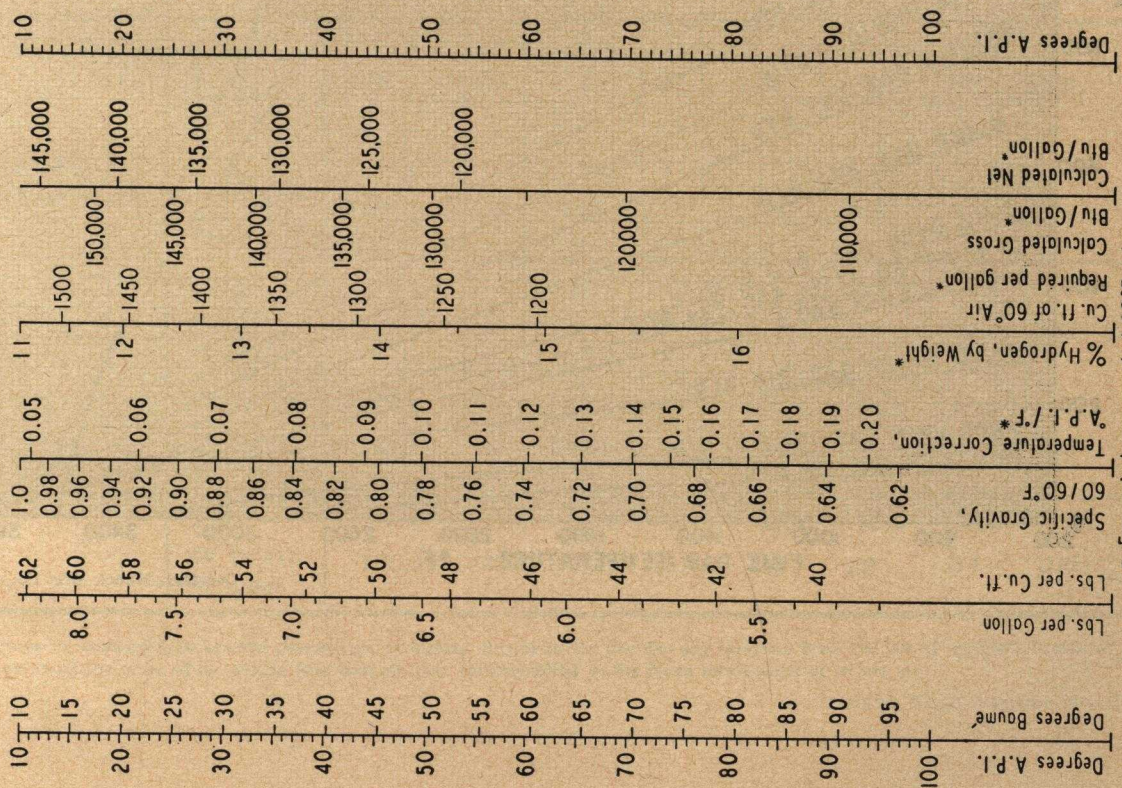
Analyses of Typical Gaseous Fuels

Type of Gas	Specific gravity	Calorific value Btu per cu ft		Gross Btu per cu ft std air	Cu ft air req'd per cu ft gas	Combustion products in cu ft per cu ft gas				Ultimate %CO ₂ in dry flue gas
		Gross	Net			CO ₂	H ₂ O	N ₂	Total	
Natural, Birmingham, Ala.	0.60	1002	904	106.2	9.44	1.00	1.95	7.51	10.46	11.8
Natural, Cleveland, Ohio ^a	0.635	1059	959	105.9	10.00	1.08	2.03	7.95	11.06	12.0
Natural, Kansas City, Mo.	0.63	974	879	106.3	9.17	0.98	1.88	7.33	10.20	11.8
Natural, Pittsburgh, Pa.	0.61	1129	1021	106.2	10.62	1.15	2.14	8.41	11.70	12.0
Blast furnace	1.02	92	92	135.3	0.68	0.39	0.01	1.14	1.54	25.5
Producer, bituminous	0.86	163	153	131.6	1.24	0.34	0.20	1.49	2.03	18.6
Coke oven, by-product	0.40	569	509	104.4	5.45	0.53	1.32	4.36	6.21	10.8
Blue (water), bituminous	0.70	260	239	126.0	2.07	0.41	0.45	2.34	3.20	14.9
Carbureted blue, low gravity	0.54	536	461	106.1	5.05	0.66	1.09	4.04	5.79	14.0
Carbureted blue, heavy oil	0.66	530	451	101.7	5.21	0.79	1.00	4.23	6.02	15.7
Sewage, Decatur	0.79	690	621	105.2	6.55	0.90	1.38	5.24	6.52	14.7
Commercial propane, natural gas	1.55	2558	2358	107.5	23.8	2.98	3.98	18.80	25.76	13.7
Commercial propane, refinery gas	1.77	2504	2316	108.0	23.2	2.99	3.74	18.35	25.08	14.0
Commercial butane, natural gas	2.04	3210	2961	104.8	30.6	3.94	4.94	24.20	33.08	14.0
Commercial butane, refinery gas	2.00	3184	2935	106.1	30.0	3.95	4.67	23.75	32.37	14.3

^aCourtesy of East Ohio Gas Co. Other data adapted from *Gaseous Fuels*, L. Shnidman (Editor), American Gas Association, N.Y., 1948.
Courtesy, North American Mfg. Co., 1956

Relation Between CO₂ Furnace Temperature, Excess Air, Fuel Loss

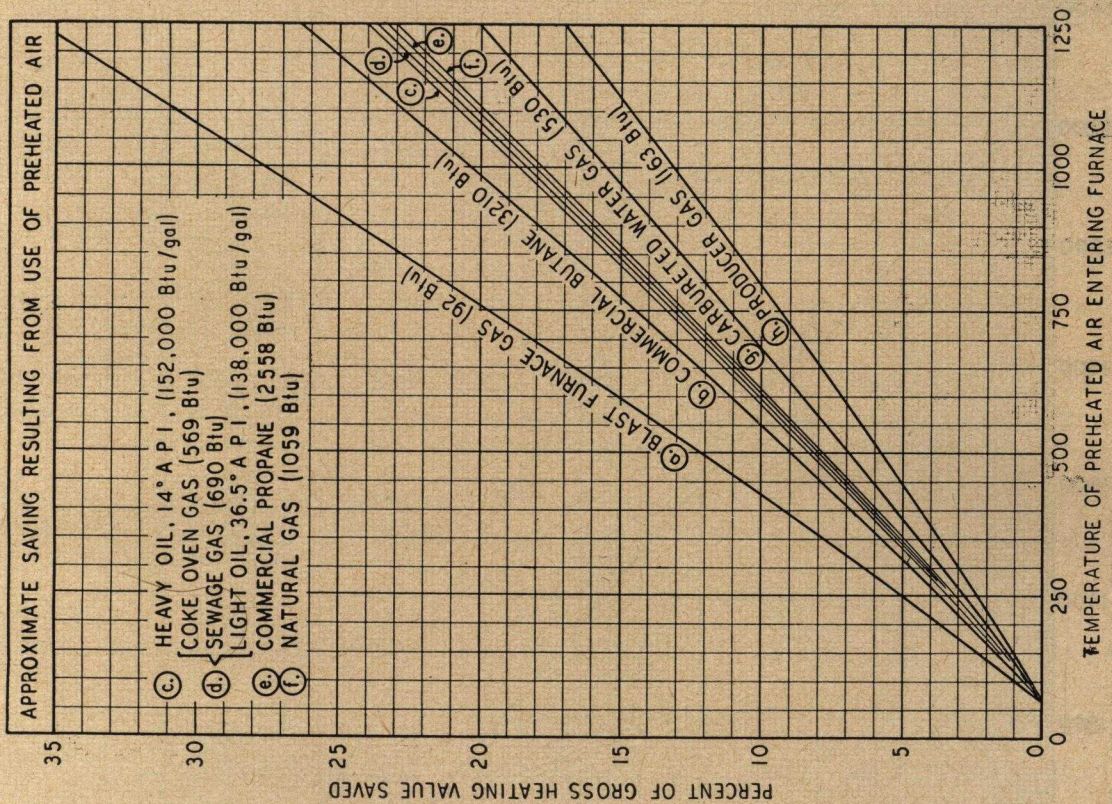
Comparison of Gravity Scales and Related Properties For Liquid Petroleum Products



* For gravity measured at 60°F only.

Courtesy, North American Mfg. Co., 1956

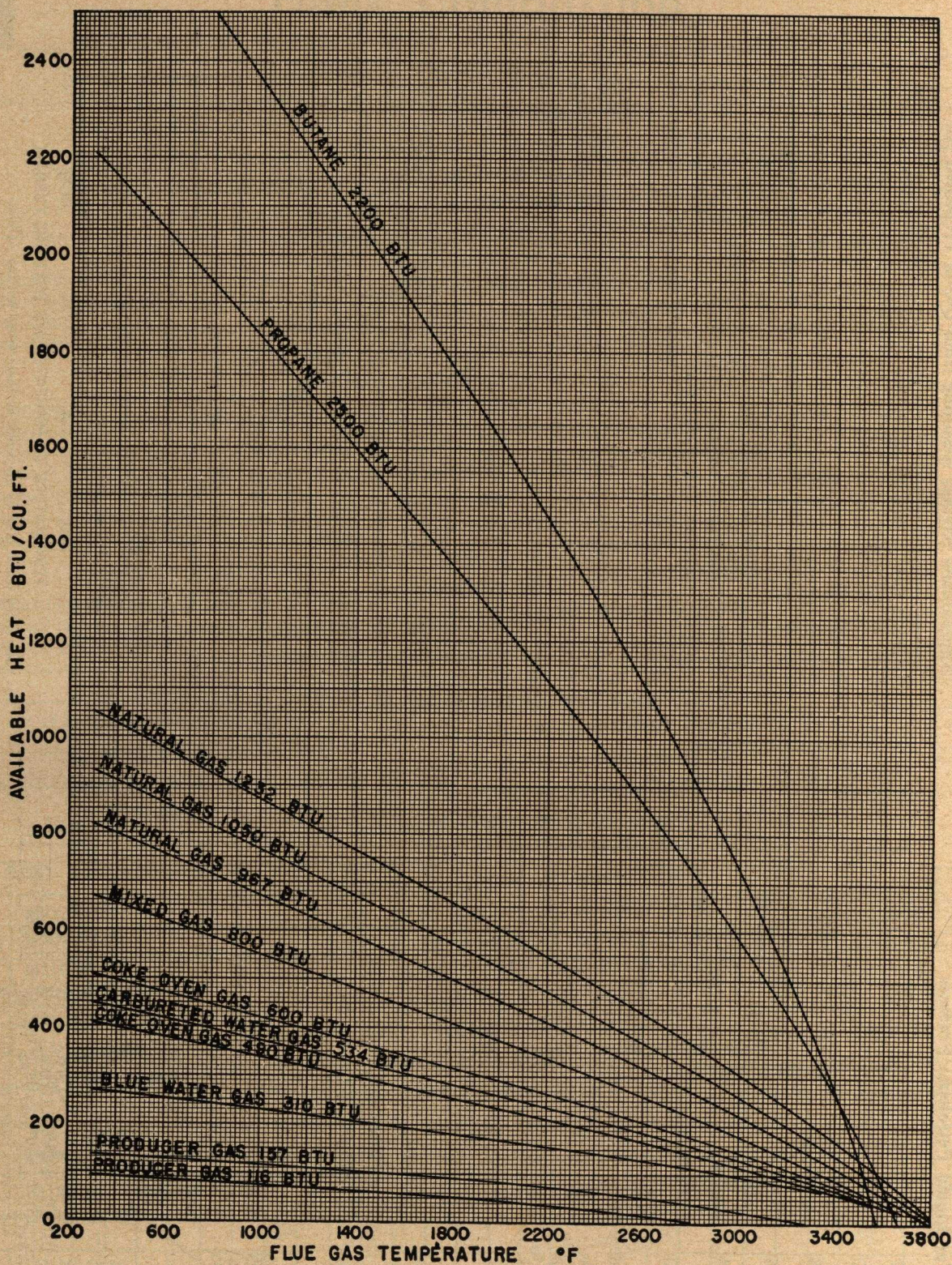
Approximate Savings Resulting from Use of Preheated Air



The fuels listed above may be identified by their gross heating values.

Courtesy, North American Mfg. Co., 1956

Available Heat from the Combustion of Flue Gases



Courtesy, Hauck Mfg. Co., 1956

Effect of Excess Air on CO₂ in Combustion Products

FUEL	% CO ₂ or cu ft air per unit fuel	% Excess Air								
		0	10	20	40	60	80	100	150	200
		% of Theoretical Air								
		100	110	120	140	160	180	200	250	300
Natural Gas (Cleveland)	% CO ₂	12.5	10.5	9.5	8.0	6.9	6.1	5.4	4.3	3.5
	<i>cu ft air cu ft gas</i>	<i>10.0</i>	<i>11.0</i>	<i>12.0</i>	<i>14.0</i>	<i>16.0</i>	<i>18.0</i>	<i>20.0</i>	<i>25.0</i>	<i>30.0</i>
Blast Furnace Gas	% CO ₂	25.5	24.4	23.4	21.7	20.1	18.8	17.7	15.3	13.5
	<i>cu ft air cu ft gas</i>	<i>0.68</i>	<i>0.75</i>	<i>0.81</i>	<i>0.95</i>	<i>1.09</i>	<i>1.22</i>	<i>1.36</i>	<i>1.70</i>	<i>2.04</i>
Producer Gas (Bituminous)	% CO ₂	18.6	17.4	16.4	14.6	13.2	12.0	11.1	9.2	7.9
	<i>cu ft air cu ft gas</i>	<i>1.24</i>	<i>1.36</i>	<i>1.49</i>	<i>1.74</i>	<i>1.98</i>	<i>2.23</i>	<i>2.48</i>	<i>3.10</i>	<i>3.72</i>
Coke Oven Gas (By-Product)	% CO ₂	10.8	9.8	8.9	7.5	6.5	5.7	5.1	4.1	3.4
	<i>cu ft air cu ft gas</i>	<i>5.45</i>	<i>6.00</i>	<i>6.54</i>	<i>7.63</i>	<i>8.72</i>	<i>9.81</i>	<i>10.9</i>	<i>13.6</i>	<i>16.4</i>
Carbureted Blue Gas (Heavy Oil)	% CO ₂	15.7	14.3	13.0	11.1	9.7	8.6	7.7	6.2	5.1
	<i>cu ft air cu ft gas</i>	<i>5.21</i>	<i>5.73</i>	<i>6.25</i>	<i>7.29</i>	<i>8.34</i>	<i>9.38</i>	<i>10.4</i>	<i>13.0</i>	<i>15.6</i>
Propane (Refinery)	% CO ₂	14.0	12.6	11.5	9.8	8.5	7.5	6.7	5.3	4.4
	<i>cu ft air cu ft gas</i>	<i>23.2</i>	<i>25.5</i>	<i>27.9</i>	<i>32.5</i>	<i>37.2</i>	<i>41.8</i>	<i>46.4</i>	<i>58.0</i>	<i>69.6</i>
Butane (Refinery)	% CO ₂	14.3	12.9	11.7	10.0	8.6	7.6	6.8	5.4	4.5
	<i>cu ft air cu ft gas</i>	<i>30.0</i>	<i>33.0</i>	<i>36.0</i>	<i>42.0</i>	<i>48.0</i>	<i>54.0</i>	<i>60.0</i>	<i>75.0</i>	<i>90.0</i>
Distillate Oil (Mid-Continent)	% CO ₂	15.2	13.8	12.6	10.7	9.3	8.2	7.4	5.9	4.9
	<i>cu ft air gal oil</i>	<i>1348</i>	<i>1483</i>	<i>1618</i>	<i>1887</i>	<i>2157</i>	<i>2426</i>	<i>2696</i>	<i>3370</i>	<i>4044</i>
Residual Oil (Mid-Continent)	% CO ₂	15.6	14.1	12.9	11.0	9.6	8.5	7.6	6.1	5.0
	<i>cu ft air gal oil</i>	<i>1480</i>	<i>1628</i>	<i>1776</i>	<i>2072</i>	<i>2368</i>	<i>2664</i>	<i>2960</i>	<i>3700</i>	<i>4440</i>
Bituminous Coal	% CO ₂	18.4	16.7	15.3	13.0	11.4	10.1	9.1	7.2	6.0
	<i>cu ft air lb coal</i>	<i>141.3</i>	<i>155.4</i>	<i>269.6</i>	<i>197.8</i>	<i>226</i>	<i>254</i>	<i>283</i>	<i>353</i>	<i>424</i>
Anthracite Coal	% CO ₂	19.8	18.0	16.5	14.1	12.4	11.0	10.0	7.9	6.6
	<i>cu ft air lb coal</i>	<i>129.7</i>	<i>142.7</i>	<i>155.6</i>	<i>181.6</i>	<i>208</i>	<i>234</i>	<i>259</i>	<i>324</i>	<i>389</i>
Coke	% CO ₂	20.4	18.5	17.0	14.5	12.7	11.3	10.2	8.1	6.8
	<i>cu ft air lb coke</i>	<i>131.9</i>	<i>145.1</i>	<i>158.3</i>	<i>183.7</i>	<i>211</i>	<i>237</i>	<i>264</i>	<i>330</i>	<i>396</i>

The figures in standard type are the percentages of carbon dioxide in the dry flue gas resulting from the use of various amounts of air. The figures in *italics* are rates of air supply (per unit of fuel) corresponding to the listed percentages of excess air.

Courtesy, North American Mfg. Co., 1956

Comparative Thermal Values of Various Fuels

Based on Their Respective Units of Weight or Volume

Natural Gas 1000 B.t.u./Cu.Ft.	1000 Cu.Ft.	550 Cu.Ft.	100 Cu.Ft.	150 Cu.Ft.	20,000 Cu.Ft.	24,000 Cu.Ft.	25,000 Cu.Ft.	26,000 Cu.Ft.	27,000 Cu.Ft.	28,000 Cu.Ft.	140 Cu.Ft.	145 Cu.Ft.	150 Cu.Ft.	155 Cu.Ft.	3,412 Cu.Ft.
Coke Oven or City Gas—550 B.t.u./Cu.Ft.	1818 Cu.Ft.	1000 Cu.Ft.	181.8 Cu.Ft.	273 Cu.Ft.	36,400 Cu.Ft.	43,700 Cu.Ft.	45,500 Cu.Ft.	47,300 Cu.Ft.	49,100 Cu.Ft.	50,800 Cu.Ft.	255 Cu.Ft.	264 Cu.Ft.	273 Cu.Ft.	282 Cu.Ft.	6.2 Cu.Ft.
Blast Furnace Gas 100 B.t.u./Cu.Ft.	10,000 Cu.Ft.	5500 Cu.Ft.	1000 Cu.Ft.	1500 Cu.Ft.	200,000 Cu.Ft.	240,000 Cu.Ft.	250,000 Cu.Ft.	260,000 Cu.Ft.	270,000 Cu.Ft.	280,000 Cu.Ft.	1400 Cu.Ft.	1450 Cu.Ft.	1500 Cu.Ft.	1550 Cu.Ft.	34 Cu.Ft.
Producer Gas 150 B.t.u./Cu.Ft.	6667 Cu.Ft.	3670 Cu.Ft.	667 Cu.Ft.	1000 Cu.Ft.	133,500 Cu.Ft.	160,000 Cu.Ft.	166,500 Cu.Ft.	173,200 Cu.Ft.	179,800 Cu.Ft.	186,500 Cu.Ft.	934 Cu.Ft.	966 Cu.Ft.	1000 Cu.Ft.	1032 Cu.Ft.	22.7 Cu.Ft.
Coke Breeze 10,000 B.t.u./Lb.	100 Lbs.	55 Lbs.	10 Lbs.	15 Lbs.	2000 Lbs.	2400 Lbs.	2500 Lbs.	2600 Lbs.	2700 Lbs.	2800 Lbs.	14 Lbs.	14.5 Lbs.	15 Lbs.	15.5 Lbs.	3.412 Lbs.
Coke 12,000 B.t.u./Lb.	83.4 Lbs.	45.8 Lbs.	8.34 Lbs.	12.5 Lbs.	1667 Lbs.	2000 Lbs.	2080 Lbs.	2162 Lbs.	2250 Lbs.	2335 Lbs.	11.7 Lbs.	12.09 Lbs.	12.5 Lbs.	12.9 Lbs.	2.84 Lbs.
Coal 12,500 B.t.u./Lb.	80 Lbs.	44 Lbs.	8 Lbs.	12 Lbs.	1600 Lbs.	1920 Lbs.	2000 Lbs.	2080 Lbs.	2160 Lbs.	2240 Lbs.	11.2 Lbs.	11.6 Lbs.	12 Lbs.	12.4 Lbs.	2.73 Lbs.
Coal 13,000 B.t.u./Lb.	77 Lbs.	42.3 Lbs.	7.7 Lbs.	11.55 Lbs.	1540 Lbs.	1845 Lbs.	1925 Lbs.	2000 Lbs.	2075 Lbs.	2156 Lbs.	10.78 Lbs.	11.15 Lbs.	11.5 Lbs.	11.9 Lbs.	2.62 Lbs.
Coal 13,500 B.t.u./Lb.	74 Lbs.	40.7 Lbs.	7.4 Lbs.	11.10 Lbs.	1480 Lbs.	1780 Lbs.	1850 Lbs.	1925 Lbs.	2000 Lbs.	2075 Lbs.	10.38 Lbs.	10.72 Lbs.	11.1 Lbs.	11.48 Lbs.	2.52 Lbs.
Coal 14,000 B.t.u./Lb.	71.5 Lbs.	39.3 Lbs.	7.15 Lbs.	10.70 Lbs.	1430 Lbs.	1712 Lbs.	1785 Lbs.	1857 Lbs.	1930 Lbs.	2000 Lbs.	10 Lbs.	10.35 Lbs.	10.7 Lbs.	10.08 Lbs.	2.44 Lbs.
Fuel Oil 140,000 B.t.u./Gal.	7.15 Gals.	3.93 Gals.	7.15 Gals.	1.07 Gals.	143 Gals.	171 Gals.	178 Gals.	185 Gals.	193 Gals.	200 Gals.	1 Gals.	1.03 Gals.	1.07 Gals.	1.108 Gals.	0.244 Gals.
Fuel Oil 145,000 B.t.u./Gal.	6.9 Gals.	3.8 Gals.	6.9 Gals.	1.03 Gals.	138 Gals.	166 Gals.	172 Gals.	179 Gals.	186 Gals.	193 Gals.	.966 Gals.	1 Gals.	1.032 Gals.	1.07 Gals.	0.235 Gals.
Fuel Oil 150,000 B.t.u./Gal.	6.67 Gals.	3.67 Gals.	6.67 Gals.	1.00 Gals.	133 Gals.	160 Gals.	167 Gals.	173 Gals.	180 Gals.	187 Gals.	.934 Gals.	.966 Gals.	1 Gals.	1.032 Gals.	0.227 Gals.
Tar 155,000 B.t.u./Gal.	6.45 Gals.	3.55 Gals.	6.45 Gals.	.968 Gals.	129 Gals.	155 Gals.	161 Gals.	168 Gals.	174 Gals.	181 Gals.	.904 Gals.	.936 Gals.	.968 Gals.	1 Gals.	0.220 Gals.
Electricity 3412 B.t.u./Kw.	293 Kw.	161 Kw.	29.3 Kw.	44 Kw.	5870 Kw.	7040 Kw.	7330 Kw.	7620 Kw.	7910 Kw.	8200 Kw.	41 Kw.	42.5 Kw.	44 Kw.	45.4 Kw.	1 Kw.

Example in Use of Chart:—What quantity of Natural Gas corresponds to 1 gal. of 145,000 B.t.u. Fuel Oil?

Solution:—On the, "Fuel Oil, 145,000 B.t.u. Gal.", line proceed horizontally to the right until the unit of Fuel Oil, namely 1 is reached. Then proceed vertically to the Natural Gas line and read 145 cu. ft. which is the equivalent of 1 gal. of the Oil.

Courtesy, Hauck Manufacturing Co., Checked 1956

Equivalent Heating Capacities of Typical Fuels

	BY-PRODUCT COKE (tons)	INDIANA BITUMINOUS (tons)	OHIO BITUMINOUS (tons)	POCAHONTAS BITUMINOUS (tons)	LIGHT OIL (gal)	MEDIUM OIL (gal)	HEAVY OIL (gal)	BLAST FURNACE GAS (1000 cu ft)	PRODUCER GAS (1000 cu ft)	WATER GAS (1000 cu ft)	CARBURETED WATER GAS (1000 cu ft)	COKE OVEN GAS (1000 cu ft)	KANSAS CITY NATURAL GAS (1000 cu ft)	PITTSBURGH NATURAL GAS (1000 cu ft)
1000 cu ft of PITTSBURGH NATURAL GAS, 1129 Btu/cu ft gross, 1021 Btu/cu ft net, is equivalent to	0.0404	0.0469	0.0409	0.0363	8.42	7.76	7.18	11.1	6.67	4.27	2.07	2.005	1.162	...
1000 cu ft of KANSAS CITY NATURAL GAS, 974 Btu/cu ft gross, 879 Btu/cu ft net is equivalent to	0.0348	0.0404	0.0352	0.0312	7.25	6.69	6.19	9.55	5.75	3.68	1.785	1.728	...	0.861
1000 cu ft of COKE OVEN GAS (by-product) 569 Btu/cu ft gross, 509 Btu/cu ft net is equivalent to	0.0202	0.0234	0.0204	0.0181	4.20	3.87	3.59	5.53	3.33	2.13	1.032	...	0.579	0.521
1000 cu ft CARBURETED WATER GAS 534 Btu/cu ft gross, 493 Btu per cu ft net is equivalent to	0.0195	0.0226	0.0198	0.0175	4.07	3.75	3.48	5.36	3.22	2.06	...	0.969	0.561	0.483
1000 cu ft WATER GAS (bituminous) 261 Btu/cu ft gross, 239 Btu per cu ft net is equivalent to	0.00946	0.01098	0.00958	0.00847	1.972	1.818	1.683	2.60	1.562	...	0.485	0.469	0.272	0.232
1000 cu ft PRODUCER GAS (bituminous) 163 Btu/cu ft gross, 153 Btu per cu ft net is equivalent to	0.00606	0.00703	0.00613	0.00543	1.262	1.163	1.078	1.662	...	0.64	0.31	0.301	0.174	0.150
1000 cu ft BLAST FURNACE GAS 93 Btu/cu ft gross, 92 Btu per cu ft net is equivalent to	0.00365	0.00423	0.00369	0.00327	0.76	0.70	0.648	...	0.602	0.385	0.210	0.181	0.1048	0.0901
1 gallon HEAVY OIL, 150,000 Btu per gal gross, 142,000 Btu per gallon net is equivalent to	0.00562	0.00652	0.00569	0.00504	1.171	1.080	...	1.543	0.928	0.594	0.288	0.279	0.1615	0.1390
1 gal MEDIUM OIL, 140,000 Btu gross, 131,500 Btu net is equivalent to	0.00520	0.00603	0.00526	0.00466	1.083	...	0.925	1.428	0.858	0.550	0.267	0.258	0.1495	0.1287
1 gal LIGHT OIL, 130,000 Btu gross 121,200 Btu net is equivalent to	0.00480	0.00557	0.00486	0.00431	...	0.921	0.853	1.318	0.791	0.507	0.216	0.238	0.1378	0.1187
1 ton POCAHONTAS BITUMINOUS COAL 14,550 Btu/lb gross, 14,097 Btu per lb net is equivalent to	1.115	1.295	1.129	...	232.5	214.1	198.3	306	184.0	117.8	57.1	55.3	32.0	27.6
1 ton OHIO HIGH-VOLATILE BITUMINOUS 12,990 Btu/lb gross, 12,480 Btu per lb. net is equivalent to	0.987	1.146	...	0.884	205.5	189.6	175.5	271	163.0	104.3	50.6	49.0	28.4	24.4
1 ton INDIANA HIGH-VOLATILE BITUMINOUS 11,420 Btu/lb gross, 10,882 Btu per lb net is equivalent to	0.861	...	0.871	0.772	179.7	165.8	153.5	237	142.3	91.1	44.2	42.8	24.8	21.3
1 ton BY-PRODUCT COKE 12,690 Btu/lb gross, 12,615 Btu per lb net is equivalent to	...	1.160	1.012	0.899	208.2	191.8	177.7	274	165.0	105.6	51.2	49.6	28.7	25.5

Courtesy, North American Mfg. Co., 1956

Comparative Fuel Costs, Based on Equivalent Heat Units Only

Any fuel at any price within range of the chart can be compared with another fuel on the chart by vertical intersections through the price lines of both fuels. For example, Natural gas at \$0.50 per 1,000 Cu. Ft. is equivalent to City Gas at \$0.275 per 1,000 Cu. Ft. or 140,000 B.T.U. Fuel Oil at \$0.07 per Gallon, etc. Actual fuel cost for heating per unit of product, must also take into consideration the efficiency of fuel application, cost of fuel handling and other related factors.

FUEL		GUIDE LINES																			
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
NATURAL GAS—1000 B.T.U. per Cu. Ft. Cost per 1000 Cu. Ft.	\$	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	
	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
CITY GAS—550 B.T.U. per Cu. Ft. Cost per 1000 Cu. Ft.	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
MIXED GAS—800 B.T.U. per Cu. Ft. Cost per 1000 Cu. Ft.	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
BLAST FURNACE GAS—100 B.T.U. per Cu. Ft. Cost per 1000 Cu. Ft.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
PRODUCER GAS—150 B.T.U. per Cu. Ft. Cost per 1000 Cu. Ft.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
COKE BREEZE—10,000 B.T.U. per Lb. Cost per Net Ton	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
COKE—12,000 B.T.U. per Lb. Cost per Net Ton	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
COAL—12,500 B.T.U. per Lb. Cost per Net Ton	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
COAL—13,000 B.T.U. per Lb. Cost per Net Ton	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
COAL—13,500 B.T.U. per Lb. Cost per Net Ton	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
COAL—14,000 B.T.U. per Lb. Cost per Net Ton	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800		
FUEL OIL 140,000 B.T.U. per Gal. Cost per Gallon	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
FUEL OIL—145,000 B.T.U. per Gal. Cost per Gallon	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
FUEL OIL 150,000 B.T.U. per Gal. Cost per Gallon	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
TAR—155,000 B.T.U. per Gal. Cost per Gallon	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
BUTANE (liquid)—102,400 B.T.U. per Gal. Cost per Gallon	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
BUTANE (gas)—3,200 B.T.U. per Cu. Ft. Cost per 1000 Cu. Ft.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950		
	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950		
PROPANE (liquid)—91,800 B.T.U. per Gal. Cost per Gallon	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19		
PROPANE (gas)—2,550 B.T.U. per Cu. Ft. Cost per 1000 Cu. Ft.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950		
	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950		
ELECTRICITY—3,412 B.T.U. per K.W. Cost per Kilowatt	0004	0008	0012	0016	0020	0024	0028	0032	0036	0040	0044	0048	0052	0056	0060	0064	0068	0072	0076		
	0004	0008	0012	0016	0020	0024	0028	0032	0036	0040	0044	0048	0052	0056	0060	0064	0068	0072	0076		

Properties of Air at Elevated Temperatures

Temperature degrees F	Gas gravity	Density in lb per cu ft	Volume of 1 cu ft 60° air (or gas)	Volume of 1 lb dry air in cu ft	Heat content of dry air			% Volume of water vapor in saturated air	Viscosity lb/sec ft	Thermal Conductivity Btu ft hr sq ft °F
					Btu/lb	Btu/cu ft of heated air	Btu/cu ft of 60° air			
60	1.000	0.0763	1.00	13.1	0	0	0	1.74	0.0000119	0.0136
80	0.962	0.0734	1.04	13.6	4.73	0.347	.361	3.45	0.0000125	0.0140
100	0.928	0.0708	1.08	14.1	9.46	0.670	.722	6.46	0.0000128	0.0145
120	0.897	0.0684	1.12	14.6	14.4	0.985	1.10	11.6	0.0000131	0.0149
140	0.867	0.0662	1.15	15.1	19.2	1.27	1.46	19.7	0.0000133	0.0153
160	0.839	0.0640	1.19	15.6	24.0	1.54	1.83	32.3	0.0000139	0.0158
180	0.812	0.0620	1.23	16.1	28.8	1.79	2.20	51.1	0.0000142	0.0162
200	0.787	0.0602	1.27	16.6	33.6	2.02	2.56	78.5	0.0000144	0.0166
250	0.733	0.0559	1.36	17.9	45.7	2.56	3.49	....	0.0000153	0.0174
300	0.684	0.0522	1.46	19.1	57.7	3.01	4.40	....	0.0000161	0.0182
400	0.604	0.0461	1.66	21.7	81.8	3.77	6.24	....	0.0000175	0.0200
500	0.541	0.0413	1.85	24.2	106	4.38	8.09	....	0.0000186	0.0214
600	0.493	0.0375	2.03	26.7	130	4.88	9.92	....	0.0000200	0.0229
700	0.450	0.0343	2.22	29.2	155	5.32	11.8	....	0.0000211	0.0243
800	0.415	0.0316	2.41	31.6	179	5.66	13.7	....	0.0000222	0.0257
900	0.383	0.0292	2.61	34.2	203	5.93	15.5	....	0.0000236	0.0270
1000	0.356	0.0272	2.81	36.8	235	6.39	17.9	....	0.0000247	0.0283
1200	0.313	0.0239	3.19	41.8	289	6.91	22.1	....	0.0000270	0.0308
1400	0.280	0.0214	3.57	46.8	343	7.32	26.2	....	0.0000292	0.0328
1600	0.253	0.0193	3.95	51.8	398	7.68	30.4	....	0.0000311	0.0346
1800	0.230	0.0176	4.34	56.9	455	8.00	34.7	....	0.0000333	0.0360
2000	0.211	0.0161	4.73	62.0	509	8.21	38.8	....	0.0000353	0.0370
2500	0.176	0.0134	5.68	74.5	....	....	....	....	....	....
3000	0.151	0.0115	6.64	87.1	....	....	....	....	....	....

Courtesy, North American Mfg. Co., 1956

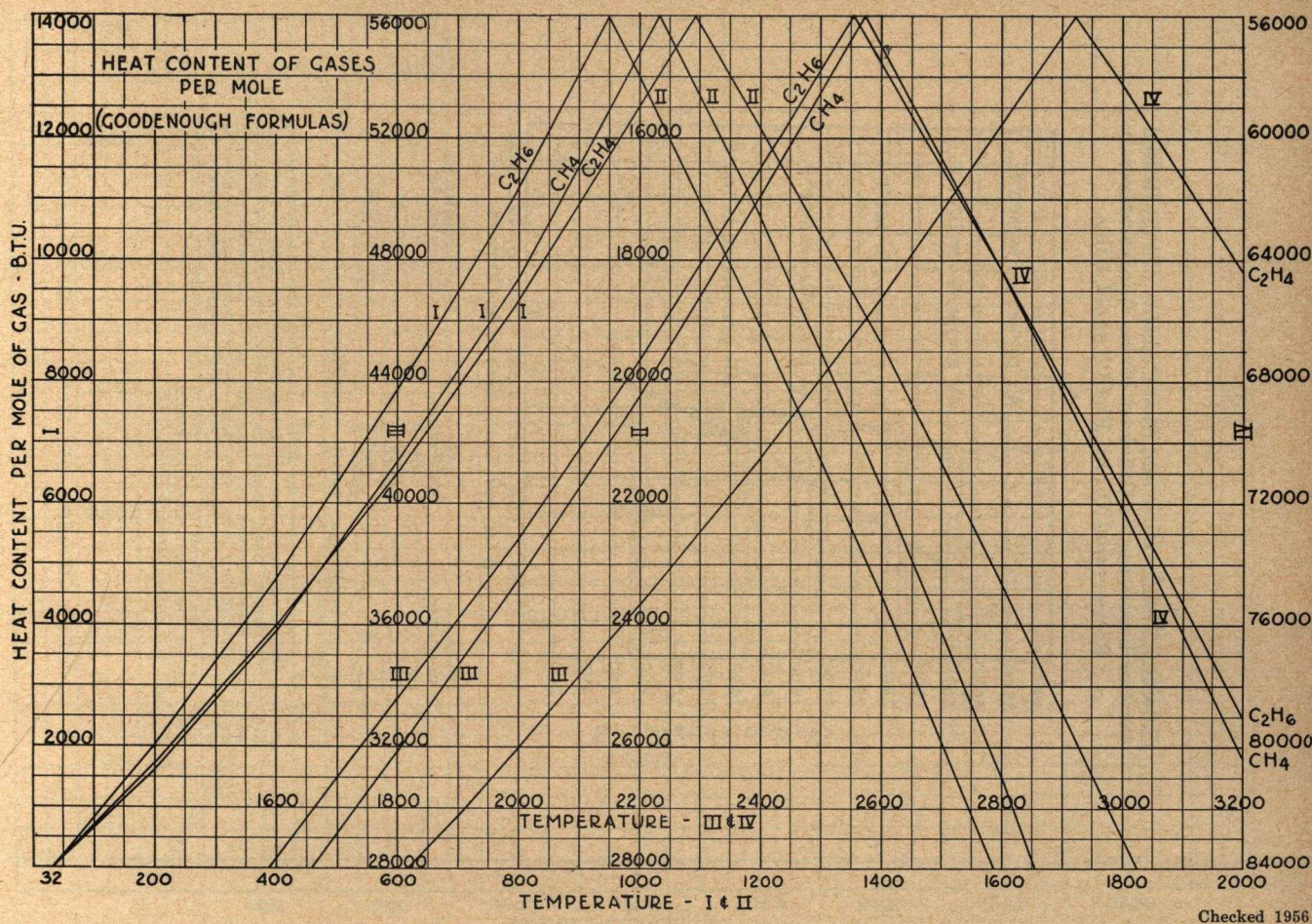
Combustion Characteristics of Chemical Compounds

Fuel	Specific volume cu ft/lb	Theoretical air required		Gross Btu per cu ft std air	Ultimate percent CO ₂	Products of perfect combustion ^a				
		cu ft/cu ft	cu ft/lb			CO ₂	H ₂ O	N ₂	SO ₂	Total
Carbon (C)	...	...	151.3	93.0	20.9	3.67	0	8.85	0	12.52
Hydrogen (H ₂)	187.7	2.39	453	135.0	....	0	1.00	1.89	0	2.89
Sulfur (S)	...	...	56.7	70.3	....	0	9.00	26.60	0	35.60
Carbon monoxide (CO)	13.51	2.39	32.5	133.7	34.6	0	0	3.32	2.00	5.32
Hydrogen sulfide (H ₂ S)	10.98	7.17	78.5	95.3	....	1.00	0	1.89	0	2.89
						1.57	0	1.90	0	3.47
						0	1.00	5.67	1.00	7.67
						0	0.53	4.68	1.88	7.09
Methane (CH ₄)	23.61	9.56	226.5	105.4	11.68	1.00	2.00	7.56	0	10.56
						2.75	2.25	13.28	0	18.28
Ethane (C ₂ H ₆)	12.50	16.72	212.0	105.2	13.15	2.00	3.00	13.22	0	18.00
						2.96	1.80	12.40	0	17.16
Propane (C ₃ H ₈)	8.45	23.9	206.5	104.9	13.70	3.00	4.00	18.90	0	25.00
						3.00	1.64	12.07	0	16.71
Butane (C ₄ H ₁₀)	6.29	31.1	203.5	104.7	14.00	4.00	5.00	24.60	0	31.60
						3.04	1.55	11.90	0	16.49
Octane (C ₈ H ₁₈)	...	...	199.0	103.5	14.42	3.09	1.42	11.67	0	16.18
Acetylene (C ₂ H ₂)	14.54	11.95	176.7	122.1	17.46	2.00	1.00	9.45	0	12.45
						3.38	0.69	10.22	0	14.29

^a Boldface figures are in cu ft/cu ft of fuel; lightface figures are in lb/lb of fuel.

Courtesy, North American Mfg. Co., 1956

Chart for Determining Heat Content of Gases



Checked 1956

Commercial Standards for Fuel Oils

Number	Grade of fuel oil Description	Flash point, °F	Pour point, °F	Water and sediment, %	Carbon residue on 10% residuum, %	Ash, %	Gravity, °API	Distillation temperatures, °F			Kinematic Viscosity							
								10% point	90% point	End point	Seconds, Saybolt				Centistokes at			
											Universal at 100° F		Furol at 122° F		100° F		122° F	
		min	max	max	max	max	min	max	max	max	max	min	max	min	max	min	max	min
1	Distillate oil intended for vaporizing pot-type burners and other burners requiring this grade. ^a	100 or legal	0	Trace	0.15	...	35	420	...	625	...	...	...	...	2.2	1.4	...	...
2	Distillate oil for general purpose domestic heating for use in burners not requiring No. 1.	100 or legal	20 ^f	0.10	0.35	...	26	(g)	675	...	40	...	...	...	(4.3)	...	...	...
4	Oil for burner installations not equipped with preheating facilities.	130 or legal	20	0.50	...	0.10	...	...	...	...	125	45	...	...	(26.4)	(5.8)	...	...
5	Residual-type oil for burner installations equipped with preheating facilities.	130 or legal	...	1.00	...	0.10	...	...	...	...	...	150	40	...	...	(32.1)	(81)	...
6	Oil for use in burners equipped with preheaters permitting a high viscosity fuel.	150 or legal	...	2.00 ^h	...	...	...	...	...	...	...	...	300	45	...	...	(638)	(92)

^a These are the detailed requirements for fuel oils suggested by the Bureau of Standards of the U. S. Department of Commerce as a voluntary standard of the trade. These requirements are listed in *Commercial Standard CS12-48* available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. (Price: 10 cents.)

^b Recognizing the necessity for low-sulfur fuel oils used in connection with heat treatment, nonferrous metal, glass and ceramic furnaces, and other special uses, a sulfur requirement may be specified in accordance with the following table:

Grade of fuel oil	Sulfur, max, percent
No. 1.....	0.5
No. 2.....	1.0
Nos 4, 5, and 6.....	No limit

Other sulfur limits may be specified only by mutual agreement between the buyer and seller.

^c It is the intent of these classifications that failure to meet any requirement of a given grade does not automatically place an oil in the next lower grade unless in fact it meets all requirements of the lower grade.

^d Grade No. 3 became obsolete with the issuance of the 1948 commercial standard for fuel oils.

^e No. 1 oil shall be tested for corrosion in accordance with ASTM Designation D130-30 for 3 hours at 122° F. The exposed copper strip shall show no gray or black deposit.

^f Lower or higher pour points may be specified whenever required by conditions of storage or use. However, these specifications shall not require a pour point lower than 0°F under any conditions.

^g The 10-percent point may be specified at 440°F maximum for use in other than atomizing burners.

^h The amount of water by distillation plus the sediment by extraction shall not exceed 2.00 percent. The amount of sediment by extraction shall not exceed 0.50 percent. A deduction in quantity shall be made for all water and sediment in excess of 1.0 percent.

Courtesy, North American Mfg. Co., 1956

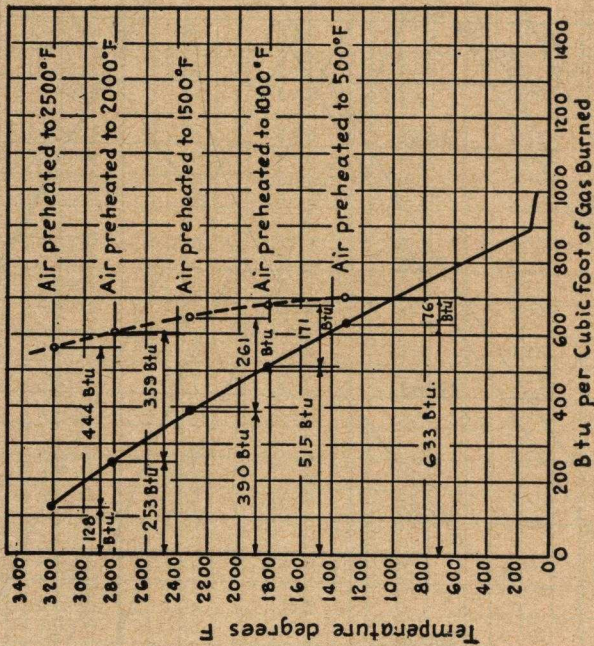
Gravities and Weights Corresponding to °API

°API	Specific gravity ^a	Pounds per gallon	°API	Specific gravity ^a	Pounds per gallon
0	1.0760	8.974	50	0.7796	6.490
1	1.0679	8.906	51	0.7753	6.455
2	1.0599	8.840	52	0.7711	6.420
3	1.0520	8.774	53	0.7669	6.385
4	1.0443	8.709	54	0.7528	6.350
5	1.0366	8.645	55	0.7587	6.316
6	1.0291	8.583	56	0.7547	6.283
7	1.0217	8.521	57	0.7507	6.249
8	1.0143	8.459	58	0.7467	6.216
9	1.0071	8.399	59	0.7428	6.184
10	1.0000	8.328	60	0.7389	6.151
11	0.9930	8.270	61	0.7351	6.119
12	0.9861	8.212	62	0.7313	6.087
13	0.9792	8.155	63	0.7275	6.056
14	0.9725	8.099	64	0.7238	6.025
15	0.9659	8.044	65	0.7201	5.994
16	0.9593	7.989	66	0.7165	5.964
17	0.9529	7.935	67	0.7128	5.934
18	0.9465	7.882	68	0.7093	5.904
19	0.9402	7.830	69	0.7057	5.874
20	0.9340	7.778	70	0.7022	5.845
21	0.9279	7.727	71	0.6988	5.817
22	0.9218	7.676	72	0.6953	5.788
23	0.9159	7.627	73	0.6919	5.759
24	0.9100	7.578	74	0.6886	5.731
25	0.9042	7.529	75	0.6852	5.703
26	0.8984	7.481	76	0.6819	5.676
27	0.8927	7.434	77	0.6787	5.649
28	0.8871	7.387	78	0.6754	5.622
29	0.8816	7.341	79	0.6722	5.595
30	0.8762	7.296	80	0.6690	5.568
31	0.8708	7.251	81	0.6659	5.542
32	0.8654	7.206	82	0.6628	5.516
33	0.8602	7.163	83	0.6597	5.491
34	0.8550	7.119	84	0.6566	5.465
35	0.8498	7.076	85	0.6536	5.440
36	0.8448	7.034	86	0.6506	5.415
37	0.8398	6.993	87	0.6476	5.390
38	0.8348	6.951	88	0.6446	5.365
39	0.8299	6.910	89	0.6417	5.341
40	0.8251	6.870	90	0.6388	5.316
41	0.8203	6.830	91	0.6360	5.293
42	0.8155	6.790	92	0.6331	5.269
43	0.8109	6.752	93	0.6303	5.246
44	0.8063	6.713	94	0.6275	5.222
45	0.8017	6.675	95	0.6247	5.199
46	0.7972	6.637	96	0.6220	5.176
47	0.7927	6.600	97	0.6193	5.151
48	0.7883	6.563	98	0.6166	5.131
49	0.7939	6.526	99	0.6139	5.109

^aWeight ratio of 1 cu ft of water at 60° F to 1 cu ft of oil at 60° F.

Courtesy, North American Mfg. Co., 1956

Estimated Temperature and Heat Capacity of Pre-Heated Air Corresponding to Different Firing Temperatures in Recuperated Direct-Fired Tunnel Kilns



Firing Temperature
1800° F.
1800° F.
2300° F.
2800° F.
3200° F.

Air Temperature
500° F.
1000° F.
1500° F.
2000° F.
2500° F.

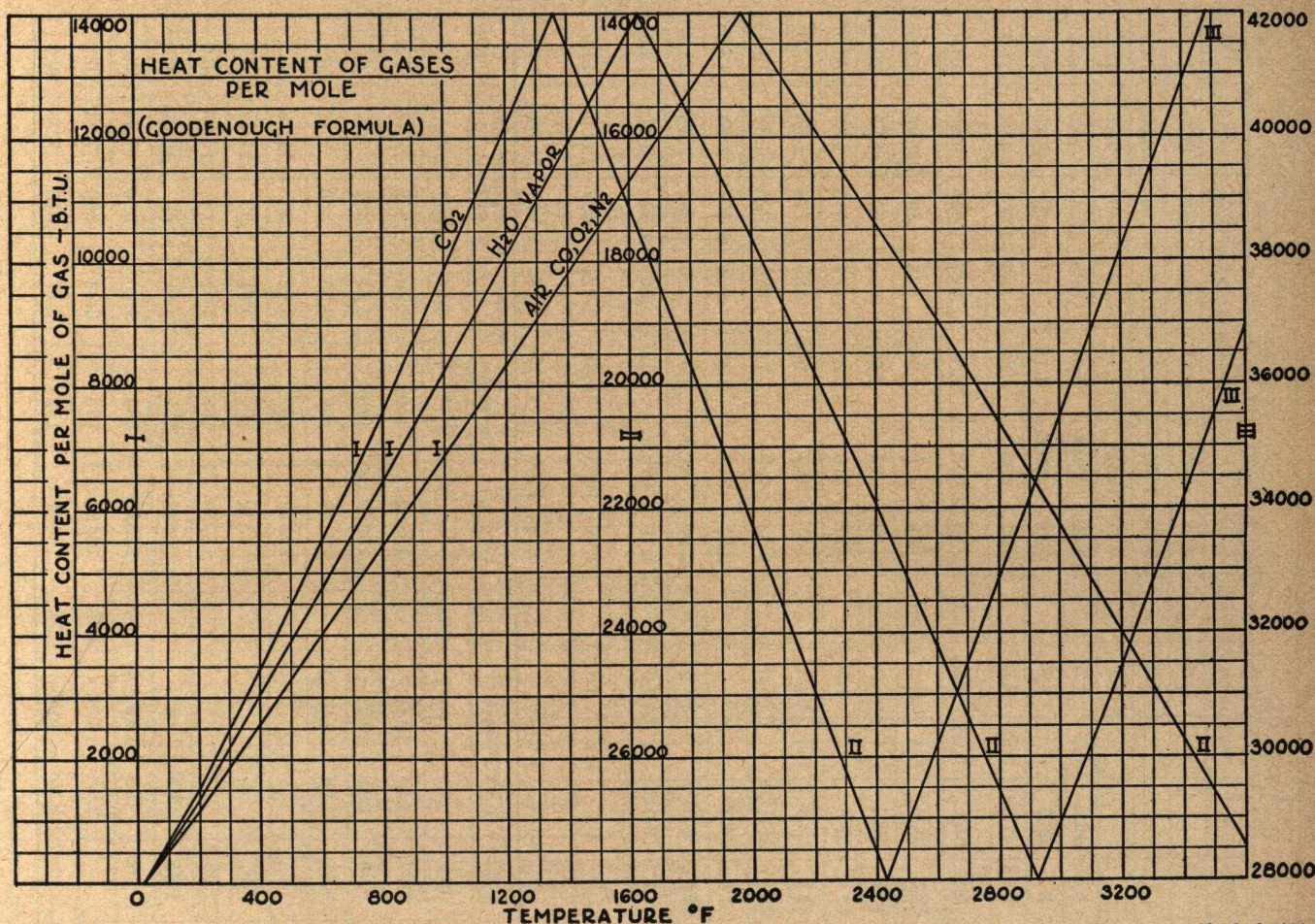
Heat Capacity on Preheated Air
76 BTU's
171 BTU's
261 BTU's
359 BTU's
444 BTU's

Curves are based upon perfect combustion of natural gas with theoretical quantity of air.

Solid curve on chart shows the BTU's available, at every temperature, in the products of combustion of natural gas burned with cold air. At 3200°, for example, these amount to 128 BTU's per cu. ft. of natural gas. Chart illustrates the fact that, with proper preheating of air by waste combustion products, very high temperatures can be attained with relatively minor increases in fuel consumption. Last column on right shows the amount of heat carried, by preheated air at various temperatures, into the combustion action.

Checked by Swindell-Dressler Corp., 1956

Chart for Determining Heat Content of Gases



Analyses of Typical Gaseous Fuels

Type of Gas	Analysis in percent by volume								
	CH ₄	C ₂ H ₆	C ₃ H ₈	C ₄ H ₁₀	CO	H ₂	CO ₂	O ₂	N ₂
Natural, Birmingham, Ala.	90.0	5.0	...	...	...	...	...	...	5.0
Natural, Cleveland, Ohio ^a	82.9	11.9	0.3	...	...	...	0.2	0.3	4.4
Natural, Kansas City, Mo.	84.1	6.7	...	...	...	...	0.8	...	8.4
Natural, Pittsburgh, Pa.	83.4	15.8	...	...	...	...	...	...	0.8
Blast furnace	...	...	...	...	27.5	1.0	11.5	...	60.0
Producer, bituminous	3.0	...	...	...	27.0	14.0	4.5	0.6	50.9
Coke oven, by-product	32.3	...	...	3.2	5.5	51.9	2.0	0.03	4.8
Blue (water), bituminous	4.6	...	...	0.7	28.2	32.5	5.5	0.9	27.6
Carbureted blue, low gravity	10.9	2.5	...	6.1	21.9	49.6	3.6	0.4	5.0
Carbureted blue, heavy oil	13.5	...	...	8.2	26.8	32.2	6.0	0.9	12.4
Sewage, Decatur	68.0	...	...	...	...	2.0	22.0	...	6.0
Commercial propane, natural gas	...	2.2	97.3	0.5	(24.3% C ₃ H ₈)				
Commercial propane, refinery gas	...	2.0	72.9	0.8					
Commercial butane, natural gas	...	...	6.0	{ 70.7n- 23.3iso- 50.1n- 16.5iso-	(28.3% C ₄ H ₁₀)				
Commercial butane, refinery gas	...	...	5.0						

^aCourtesy of East Ohio Gas Co. Other data adapted from *Gaseous Fuels*, L. Shnidman (Editor), American Gas Association, N.Y., 1948.

Combustion Characteristics of Fuels

Number	KIND OF GAS	CONSTITUENTS OF GAS — % BY VOLUME										Specific Gravity	B.T.U./ Cu. Ft. 60° F.	Cu. Ft. Air/ Cu. Ft. Gas for Combustion	Products of Combustion per Volume of Gas			Ultimate % CO ₂
		CH ₄	C ₂ H ₆	C ₂ H ₄	CO ₂	CO	H ₂	O ₂	N ₂	C ₄ H ₆	CO ₂				H ₂ O Vapor	N ₂		
1	Natural Gas, Mid-Continental	96.0			0.8				3.2		0.57	967	9.19		.968	1.92	7.30	11.7
2	Natural Gas, Ohio	80.5	18.2						1.3		0.65	1131	10.8		1.17	2.16	8.55	12.1
3	Natural Gas, Pennsylvania	67.6	31.3						1.1		0.71	1232	11.7		1.30	2.29	9.26	12.3
4	Manufactured Coal Gas	40.0		4.2	1.8	6.0	46.0	0.5	1.5		0.40	639.8	5.64		.562	1.34	4.46	11.1
5	Solvay Coke Oven Gas	22.6		3.0	3.0	8.7	56.9		5.8		0.38	489.6	4.18		.40	1.08	3.35	10.7
6	Koppers Coke Oven Gas	33.95		5.15	2.56	6.08	47.88	0.57	3.81		0.41	600	5.28		.529	1.26	4.21	11.2
7	Carburetted Water Gas	20.0		12.05	0.22	25.9	36.5	0.03	3.3	2.0	0.59	673	5.84		.822	1.066	4.65	15.0
8	Water Gas	2.0			5.3	45.0	45.0	0.5	2.2		0.58	312.5	2.32		.545	.49	1.84	22.6
9	Theoretical Water Gas					50.0	50.0				0.52	325	2.39		.50	.50	1.89	20.9
10	Blue Water Gas				3.5	43.4	51.8		1.3		0.52	310	2.28		.469	.518	1.81	20.5
11	Producer Gas, Bituminous Coal	2.5		0.4	2.5	27.0	12.0	0.3	55.3		0.87	157	1.22		.328	.178	1.53	17.6
12	Producer Gas, Anthracite Coal	0.31		0.31	6.57	25.07	18.73		49.01		0.83	150	1.12		.326	.200	1.38	19.1
13	Oil Gas	58.3	17.4				24.3				0.51	943	8.65		.931	1.757	6.85	12.0
14	Blast Furnace Gas				14.48	22.81	5.07		57.64		1.00	81.3	0.67		.373	0.051	1.10	24.4
15	Sewer Gas	68.0			22.0		2.0		6.0		0.79	690.0	6.52		.90	1.38	5.21	12.0
16	Refinery Oil Gas — Liquid Phase Cracking	4.4	72.5			1.2	6.1	0.2	0.6		1.00	1665	15.35		1.926	2.654	12.208	13.6
17	Refinery Oil Gas — Vapor Phase Cracking	23.3	21.7		0.1	1.2	13.1	1.0			0.88	1465	13.20		1.789	2.119	10.626	14.4

Number	KIND OF FUEL	CONSTITUENTS OF FUEL — % BY WEIGHT							B. T. U. Per Lb.	Cu. Ft. Air Per Lb. For Combustion	Products of Combustion Lbs. Per Lb. of Fuel			Ultimate % CO ₂
		H ₂	C	N ₂	O ₂	S	Ash	CH ₄			CO ₂	H ₂ O Vapor	N ₂	
1	Pocahontas Coal	3.92	80.9	1.06	2.97	.56	10.6		13762	140	2.96	.352	8.15	17.2
2	Pittsburgh Coal	4.82	76.6	1.55	4.99	1.41	10.7		13365	136	2.81	.434	7.97	16.2
3	Illinois Coal	4.66	69.6	1.49	9.55	2.08	12.6		10433	122	2.56	.420	7.17	16.3
4	Heavy Oil, Pennsylvania	13.7	84.9	7	.7				19210	190	3.12	1.23	11.18	15.1
5	Light Oil, Pennsylvania	14.8	82.0	1.6	1.6				17930	190.5	3.01	1.33	11.16	14.9
6	Heavy Oil, Ohio	13.1	84.2	1.35	1.35				18750	186	3.09	1.18	10.96	15.3
7	Beaumont Oil, Texas	10.9	84.6	1.45	1.45	1.63			19080	178	3.11	.98	10.45	16.0
8	Pittsburgh Coke		86.41			.92	12.53	1.06	12631	134	3.20	.024	7.84	20.6
9	Illinois Coke		85.48			2.08	12.30	2.22	12427	136	3.24	.050	7.94	20.3
10	West Virginia Coke		86.01			1.19	13.26	.73	12591	132	3.17	.016	7.75	20.5

From "Data on Industrial Heating Processes" by Surface Combustion Corp. with additions by Hauck Manufacturing Co.

Vapor Pressures, Pounds Per Square Inch Absolute

Temperature, °F	Acetylene, C ₂ H ₂	Ammonia, NH ₃	Benzene, C ₆ H ₆	n-Butane, C ₄ H ₁₀	Iso-butane, C ₄ H ₁₀	Carbon dioxide, CO ₂	Carbon disulfide, CS ₂	Ethane, C ₂ H ₆	Ethyl alcohol, C ₂ H ₅ OH	Ethyl chloride, C ₂ H ₅ Cl	Hydrogen sulfide, H ₂ S	Methyl chloride, CH ₃ Cl	Naphthalene, C ₁₀ H ₈	Propane, C ₃ H ₈	Sulfur dioxide, SO ₂	Toluene, C ₇ H ₈	Water, H ₂ O	m-Xylene, C ₈ H ₁₀
-20	162	18.30	...	...	7.50	215.02	0.53	158	0.022	2.16	57.5	11.75	...	25.4	5.883	...	...	...
-10	196	23.74	...	...	9.28	257.46	0.74	185	0.036	2.94	70.0	15.0	...	31.4	7.863	...	...	...
0	232	30.42	...	7.3	12.1	305.5	1.00	218	0.058	3.93	84.0	18.8	...	38.2	10.35	...	...	...
10	271	38.51	...	9.3	14.8	360.2	1.36	250	0.090	5.13	100	23.3	...	46.5	13.42	...	...	...
20	319	48.21	...	11.8	18.2	421.8	1.80	290	0.140	6.65	120	28.8	...	55.5	17.18	...	...	...
30	372	59.74	0.48	14.4	23.3	490.8	2.30	334	0.220	8.40	143	35.2	0.000096	66.3	21.70	0.125	...	0.031
32	387	62.29	0.52	15.8	23.2	505.5	2.46	346	0.236	8.85	150	36.6	0.00011	68.0	22.47	0.137	0.0887	0.034
40	430	73.32	0.66	18.4	26.9	567.8	2.96	381	0.330	10.53	169	42.6	0.00018	78.0	27.10	0.176	0.1217	0.042
50	495	89.19	0.88	22.7	32.2	653.6	3.83	418	0.456	13.20	197	51.5	0.00034	91.8	33.45	0.247	0.1780	0.061
60	565	107.6	1.14	27.1	38.7	748.6	4.75	496	0.640	16.5	230	61.6	0.00060	107.1	40.93	0.335	0.2561	0.093
70	645	128.8	1.51	32.7	45.8	853.4	5.93	560	0.910	20.0	267	73.3	0.0011	124.0	49.62	0.455	0.3628	0.131
80	735	153.0	1.95	39.0	53.9	968.7	7.30	632	1.25	24.3	302	85.3	0.0013	142.8	59.68	0.607	0.5067	0.178
90	830	180.6	2.51	46.2	63.3	...	9.00	708	1.71	29.0	344	102.1	0.0023	164.0	71.25	0.790	0.6980	0.241
100	...	211.9	3.20	55.0	74.7	...	10.8	...	2.32	34.9	392	118.8	0.0054	187.0	84.52	1.03	0.9487	0.330
110	...	247.0	4.05	64.2	85.1	...	13.3	...	3.09	41.1	442	137.6	0.0088	212.0	99.76	1.32	1.274	0.435
120	...	286.4	4.22	75	98.0	...	16.0	...	4.02	48.1	500	158.8	0.0142	240.0	120.9	1.70	1.692	0.570
130	...	329	6.41	87	112.0	...	19.0	...	5.27	56.3	560	173	0.0218	272	135.0	2.13	2.221	0.745
140	...	379	7.53	101	126.8	...	22.6	...	6.82	66.1	632	200	0.0322	...	157.8	2.70	2.887	0.978
150	...	435	9.2	115	...	...	26.5	...	8.65	76.0	700	223	0.0439	...	181	3.30	3.716	1.22
160	...	495	11.0	132	...	...	30.9	...	10.9	86.3	778	253	0.071	...	209	4.03	4.739	1.53
170	...	560	13.0	151	...	...	35.9	...	13.5	99.0	862	287	0.105	...	239	5.00	5.990	1.94
180	...	640	15.4	172	...	...	41.9	...	17.0	113	962	322	0.155	...	272	6.02	7.510	2.42
190	...	715	18.2	194	...	...	48.0	...	21.0	127	1050	360	0.217	...	309	7.3	9.336	2.98
200	...	800	21.7	219	...	...	55.2	...	25.5	142	1160	400	0.277	...	350	8.7	11.525	3.62
210	...	890	25.4	248	...	...	63.0	...	31.1	161	1280	445	0.347	...	399	10.3	14.123	4.42
220	...	990	...	...	...	...	71.5	...	37.8	180	...	495	0.419	...	449	...	17.188	5.30
230	...	1100	...	...	...	...	81.6	...	45.7	203	...	550	0.547	...	501	...	20.78	6.35
240	...	1210	...	...	...	...	91.8	...	54.5	230	...	605	0.68	...	561	...	24.97	7.55
250	...	1340	...	...	...	...	103	...	64.5	260	...	670	0.85	...	624	...	29.82	9.0

^a Gas Chemists Handbook, Third Edition, 1929.

^b Gas Engineers' Handbook, First Edition, 1934.

^c Handbook of Butane-Propane Gases, Second Edition, 1935.

^d Handbook of Chemistry and Physics, Nineteenth Edition, 1934.

^e Heating and Ventilating, September and October 1938.

^f L. S. Marks, Mechanical Engineers' Handbook, Third Edition, 1930.

^g J. H. Keenan, "Steam Tables and Mollier Diagram," 1930.

^h U. S. Bur. of Standards, Circular No. 142, 1923.

Note: Over small temperature intervals the logarithm of the vapor pressure plotted against temperature is practically a straight line. For longer temperature intervals the plot against reciprocal of the absolute temperature should be used.

Combustion Reactions

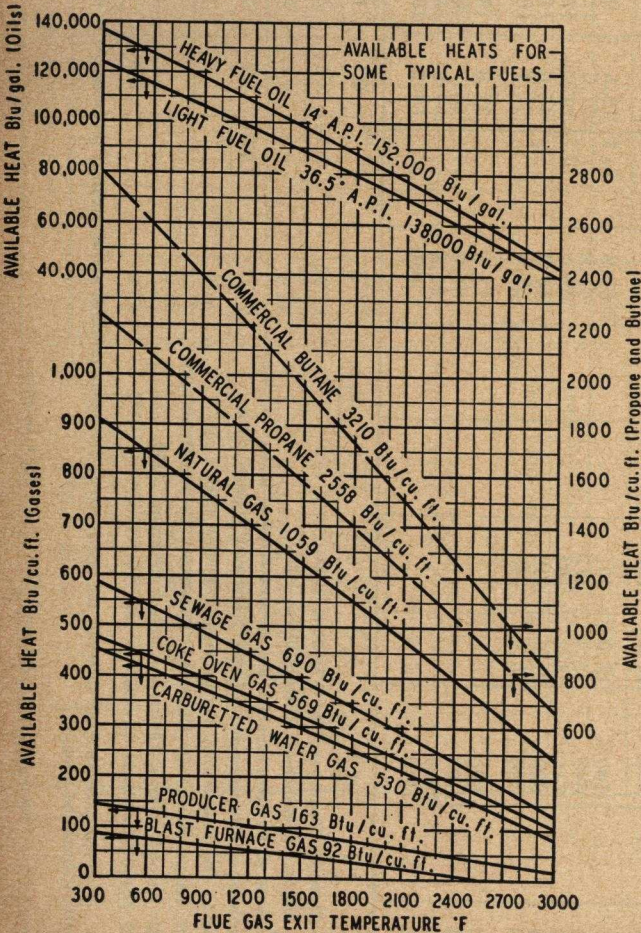
Heats of Combustion at 60° F. and Flame Temperatures for Carbon, Hydrogen, and Some of Their Components.

Carbon as Graphite
The cubic foot is measured at 60° F and 30 in. Hg.
Densities of C₂H₆, C₄H₈, C₆H₁₂, and C₈H₁₈ computed from the gas laws.
All gases are dry.
l = liquid, s = solid.
*Computed from I.C.T. values.

Reaction	Heat of combustion at 60° F			Max. flame temp., °F; corrected for dissociation (burned with theoret. air)
	Gross	Net	Btu per lb or cu ft	
C + 1/2O ₂ → CO	3,964.	3,964.	lb	
C + O ₂ → CO ₂	14,155.	14,155.	lb	3,820
CO + 1/2O ₂ → CO ₂	323.4	323.4	cu ft	3,960
H ₂ + 1/2O ₂ → H ₂ O	325.1	274.8	cu ft	3,960
CH ₄ + 2O ₂ → CO ₂ + 2H ₂ O	1,010.7	909.8	cu ft	3,640
C ₂ H ₆ + 3 1/2O ₂ → 2CO ₂ + 3H ₂ O	1,783.3	1,630.4	cu ft	3,710
C ₃ H ₈ + 5O ₂ → 3CO ₂ + 4H ₂ O	2,572.	2,365.	cu ft	3,770
C ₄ H ₁₀ (iso) + 6 1/2O ₂ → 4CO ₂ + 5H ₂ O	3,353.	3,093.	cu ft	3,780
C ₅ H ₁₂ (n) + 8O ₂ → 5CO ₂ + 6H ₂ O ..	3,987.	3,685.	cu ft	3,720
C ₂ H ₂ + 3O ₂ → 2CO ₂ + 2H ₂ O	1,606.1	1,504.6	cu ft	3,910
C ₃ H ₆ + 4 1/2O ₂ → 3CO ₂ + 3H ₂ O ...	2,332.	2,181.	cu ft	3,830
C ₄ H ₈ (iso) + 6O ₂ → 4CO ₂ + 4H ₂ O ..	3,077.	2,876.	cu ft	3,810
C ₂ H ₄ + 2 1/2O ₂ → 2CO ₂ + H ₂ O	1,498.3	1,447.4	cu ft	4,250
C ₆ H ₆ + 7 1/2O ₂ → 6CO ₂ + 3H ₂ O	3,744.	3,593.	cu ft	3,860
C ₇ H ₈ + 9O ₂ → 7CO ₂ + 4H ₂ O	17,980.	17,250.	lb	3,840
C ₈ H ₁₀ + 12O ₂ → 8CO ₂ + 5H ₂ O	18,300.	17,470.	lb	3,850
C ₁₀ H ₈ + 12O ₂ → 10CO ₂ + 4H ₂ O	17,290.	16,690.	lb	

Courtesy, Hauck Mfg. Co.

Available Heats for Some Typical Fuels



Courtesy, The North American Mfg. Co.
Checked 1956

Working Temperatures of Fuel Oil

Spec. Grav. Baumé (A.P.I.)	Oil Temp. (Fahr.)
11°	300°
12°	280°
13°	260°
14°	250°
15°	240°
16°	230°
17°	215°
18°	200°
19°	185°
20°	170°
21°	155°
22°	140°
23°	130°
24°	120°
25°	110°
26°	100°
27°	90°
28°	80°

Checked 1956

Heat Transfer

7

Conductivities of Metals (Continued)

Metal	Den- sity lb per cu ft at 68°F	Spec- ific heat Btu/lb at 68°F	Conductivity, Btu ft/hr sq ft °F						
			at 32°F 0°C	at 392°F 200°C	at 752°F 400°C	at 1112°F 600°C	at 1472°F 800°C	at 1832°F 1000°C	at 2192°F 1200°C
Nickel:									
Pure (99.9%)	556	0.1065	54	42	34	..	..	..	..
Impure (99.2%)	556	0.106	40	34	30	32	36	39	40
Ni-Cr (90% Ni)	541	0.106	9.9	12.1	14.2	..	..	..	..
Ni-Cr (80% Ni)	519	0.106	7.1	9.0	10.9	13.0	..	..	..
Silver:									
Purest	657	0.0559	241	238	..	..	..	..	..
Pure (99.9%)	657	0.0559	237	216	208	..	..	..	..
Steel:									
Carbon (0.5% C)	489	0.111	32	28	24	20	18	17	18
Carbon (1.0% C)	487	0.113	25	24	21	19	17	16	17
Carbon (1.5% C)	484	0.116	21	21	19	18	16	16	17
Chrome (1% Cr)	491	0.11	36	30	24	21	19	19	..
Chrome (2% Cr)	491	0.11	31	26	22	19	18	18	..
Chrome (5% Cr)	489	0.11	23	21	19	17	17	17	17
Chrome-Nickel	488	0.11	9.4	10	11	13	15	18	..
Nickel-Chrome	491	0.11	8.1	8.7	10	11	13	..	..
Manganese Steel	491	0.11	22	21	20	19	..	..	..
Tungsten Steel	497	0.106	36	31	26	21	..	..	..
Tin (pure)	456	0.0541	38.1	33	..	..	..	..	..
Tungsten	1208	0.0321	96	82	73	65	44	..	..
Zinc (pure)	446	0.0918	65	61	54	..	..	..	..

a Adapted by permission from B. Koch: Grundlagen des Wärmeaustausches (Stoffwerte) Dissen, Germany, 1950.

Courtesy, North American Mfg. Co., 1956

Conductivities of Metals

Metal	Den- sity lb per cu ft at 68°F	Spec- ific heat Btu/lb at 68°F	Conductivity, Btu ft/hr sq ft °F						
			at 32°F 0°C	at 392°F 200°C	at 752°F 400°C	at 1112°F 600°C	at 1472°F 800°C	at 1832°F 1000°C	at 2192°F 1200°C
Aluminum:									
Pure	169	0.214	132	132	..	..	..	..	..
Duralumin	174	0.211	92	112	..	..	..	..	..
Hydronalium	163	0.216	63	82	..	..	..	..	..
Silumin	166	0.208	94	107	..	..	..	..	..
Silumin (copper-bearing)	166	0.207	79	88	..	..	..	..	..
Alusil	164	0.204	91	101	..	..	..	..	..
Al-Mg-Si	169	0.213	101	118	..	..	..	..	..
Copper:									
Pure	559	0.0915	223	216	210	204	..	..	..
Red Brass	544	0.092	34	..	..	..	..	..	..
Brass	532	0.092	..	83	85	..	..	..	..
German Silver	538	0.094	..	23	28	..	..	..	..
Constantan	557	0.098	..	15	..	..	..	..	..
Iron:									
Pure	493	0.108	42	36	28	23	21	20	21
Wrought (5% C)	490	0.11	34	30	26	21	19	19	19
Cast (4% C)	454	0.10	..	..	..	..	..	..	..
Lead	710	0.031	20.3	18.2	..	..	..	..	..
Magnesium:									
Pure	109	0.242	99	94	..	..	..	..	..
Mg-Al	113	0.24	30	43	..	..	..	..	..
Mg-Mn	111	0.24	64	75	..	..	..	..	..
Molybdenum	638	0.06	79	..	..	..	..	..	..

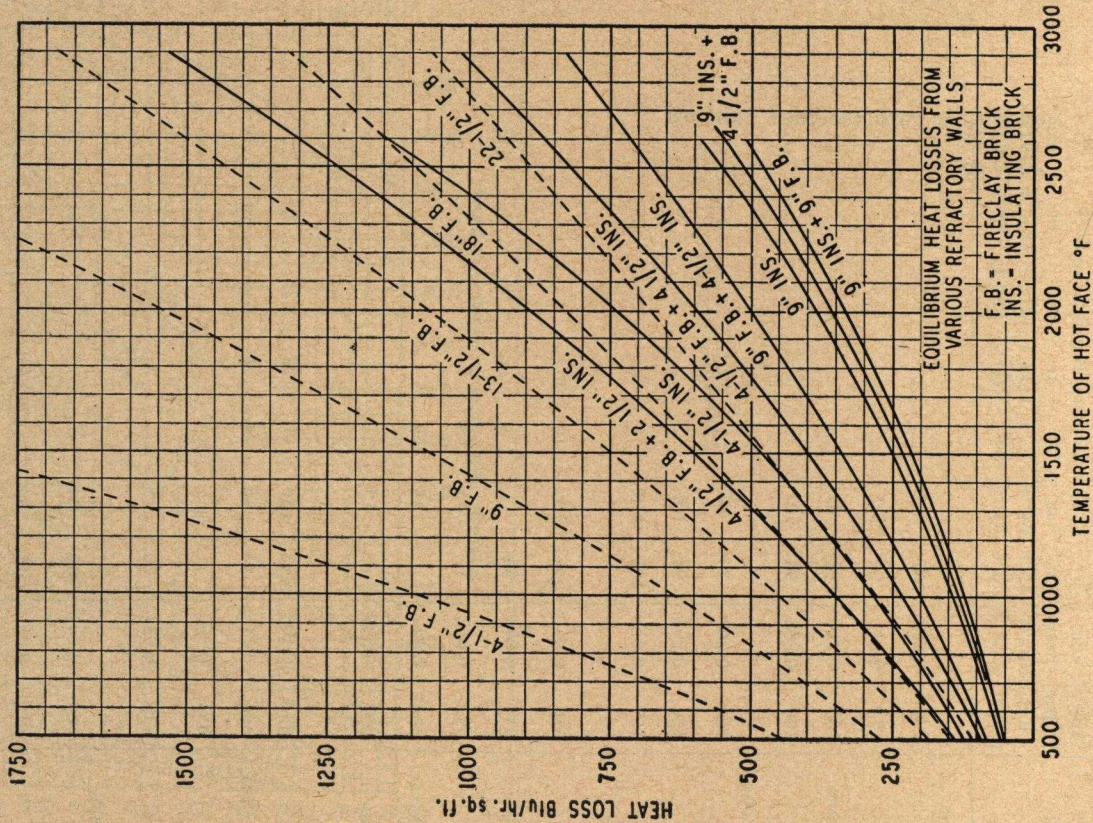
Courtesy, North American Mfg. Co., 1956

Conductivities of Miscellaneous Solid Substances
(Including Building Materials)

Description of material	Conductivity		Bulk density lb/cu ft	Mean temperature °F	Reference number
	Btu ft hr sq ft °F	Btu in. hr sq ft °F			
Asbestos	0.122	1.76	36.0	500	3
Asbestos mill board	0.07	0.84	60.5	86	3
Asbestos paper, corrugated	0.031	0.37	16	100	1
Asbestos paper, corrugated, laminated	0.038	0.45	22	100	1
Brick, common yellow	0.40	4.8	...	...	2
Brick, damp or wet	0.42	5.0	...	...	2
Brick masonry	0.33-0.42	3.96-5.04	...	...	3
Cardboard, corrugated	0.37	4.44	...	70	3
Carborundum brick	10.7	128.3	129	1112	3
Celluloid	0.12	1.44	87.3	86	3
Cement mortar	1.00	12.00	...	...	2
Cement plaster	0.667	8.00	...	...	2
Clinker, granular	0.27	3.24	...	32-1300	3
Coke, petroleum	3.4	40.8	...	212	3
Concrete, light weight aggregate	0.202	2.42	65	75	2
Concrete, sand and gravel aggregate	1.05	12.6	142	75	2
Cork, granulated, coarse	0.027-0.029	0.32-0.35	5.4	23	1
Cork, granulated, fine	0.028	0.30	6.5	32	1
Corkboard	0.021-0.027	0.25-0.32	5.4-14.5	90	1
Corkboard, dense	0.029	0.35	20.7	121	1
Cotton wool	0.024	0.288	5.06	32	3
Felt, hair	0.021	0.25	11.0	75	2
Felt, wool	0.030	0.360	20.6	86	3
Glass	0.333-0.5	4.00-6.00	...	...	3
Glass wool	0.023	0.27-0.28	1.4-4.8	100	1
Granite	1.0-2.32	12.0-27.8	...	...	3
Graphite, powdered	0.104	1.25	30	104	3
Graphite, solid	86.7	1040	...	32	3
Gypsum board	0.118	1.41	62.8	70	2
Gypsum plaster	0.275	3.30	...	...	2
Hair felt	0.021	0.25	11.0	75	2
Ice	1.26	15.1	57.5	...	3
Infusorial earth	0.06	0.72	20	32-1200	3
Insulating board (wood fiber)	0.028	0.33	13.5-15.9	70	2
Insulating board (cane fiber)	0.028	0.33	14.4	100	2
Kapok	0.020	0.24	0.9-1.0	68-90	2
Lampblack	0.038	0.456	10.0	104	3
Lava	0.49	5.88	...	...	3
Leather, sole	0.092	1.103	62.4	...	3

Courtesy, North American Mfg. Co., 1956

Equilibrium Heat Losses From Various Refractory Walls



Courtesy, North American Mfg. Co., 1956

Heat Losses^a From Horizontal Pipes
With Air Cell^b Type Insulation

Nominal pipe size in inches	Insulation thickness	Temperature difference (pipe to air) °F			
		50	100	150	200
½	2-ply (½")	11.2	23.8	37.8	53.4
	3-ply (¾")	10.1	21.3	33.7	47.3
	4-ply (1")	9.3	19.7	31.1	41.5
¾	2-ply (½")	12.7	27.1	43.1	60.8
	3-ply (¾")	11.3	24.0	38.1	53.6
	4-ply (1")	10.4	22.0	34.8	48.9
1	2-ply (½")	14.7	31.3	49.9	70.7
	3-ply (¾")	13.0	27.6	43.7	61.4
	4-ply (1")	11.8	25.0	39.6	55.7
1¼	2-ply (½")	17.2	36.7	58.3	82.7
	3-ply (¾")	15.0	31.8	50.4	71.0
	4-ply (1")	13.5	28.6	45.4	63.9
1½	2-ply (½")	19.0	40.4	64.3	91.0
	3-ply (¾")	16.4	34.7	55.0	77.3
	4-ply (1")	14.7	30.2	49.4	69.3
2	2-ply (½")	22.3	47.6	75.8	107.5
	3-ply (¾")	19.1	40.6	64.4	90.5
	4-ply (1")	17.0	36.1	57.2	80.3
2½	2-ply (½")	25.8	55.0	87.8	154.8
	3-ply (¾")	22.0	46.5	73.7	103.8
	4-ply (1")	19.4	41.1	65.1	91.5
3	2-ply (½")	30.3	64.6	103.4	146.7
	3-ply (¾")	25.5	53.9	85.6	120.8
	4-ply (1")	22.4	47.4	75.2	106.0
3½	2-ply (½")	33.8	72.1	118.2	167.5
	3-ply (¾")	28.3	60.0	95.3	138.0
	4-ply (1")	24.7	52.4	83.0	121.0
4	2-ply (½")	37.3	79.4	127.2	180.0
	3-ply (¾")	31.5	65.9	104.8	147.7
	4-ply (1")	27.0	77.2	91.0	128.2

a In Btu per hr per linear ft. b Corrugated asbestos paper.

Courtesy, North American Mfg. Co., 1956

Heat Losses from Horizontal Pipes^a
With 85% Magnesia Insulation^b

Nominal pipe size in inches	Insulation thickness	Temperature difference (pipe to air) °F				
		100	200	300	400	500
½	⅞" std.	15.8	33.2	51.9	72.0	93.5
	1 ²⁹ / ₃₂ " dbl. std.	11.4	23.7	36.9	51.0	66.1
¾	⅞" std.	18.1	37.8	59.1	82.4	107
	1 ²⁹ / ₃₂ " dbl. std.	12.7	26.4	41.1	56.9	73.5
1	⅞" std.	20.6	43.2	67.8	94.4	122
	1 ²⁹ / ₃₂ " dbl. std.	14.2	29.5	46.0	63.6	82.4
1¼	⅞" std.	24.2	50.6	79.5	110	143
	1 ²⁹ / ₃₂ " dbl. std.	16.1	33.6	52.4	72.5	93.9
1½	⅞" std.	26.4	55.3	86.7	121	157
	1 ²⁹ / ₃₂ " dbl. std.	17.4	36.3	56.6	78.3	101
2	1½" std.	28.2	59.0	92.4	128	167
	2 ⁵ / ₃₂ " dbl. std.	18.6	38.8	60.5	83.5	108
2½	1½" std.	32.3	67.6	106	147	192
	2 ⁵ / ₃₂ " dbl. std.	20.9	43.6	67.8	94.0	122
3	1½" std.	37.7	78.8	123	171	222
	2 ⁵ / ₃₂ " dbl. std.	23.8	49.8	77.4	107	139
3½	1½" std.	41.6	87.3	137	191	249
	2 ⁵ / ₃₂ " dbl. std.	26.1	54.2	84.7	117	152
4	1½" std.	43.0	90.2	141	197	256
	2¼" dbl. std.	27.5	57.2	89.4	124	160
5	1½" std.	51.5	108	170	236	307
	2 ⁵ / ₁₆ " dbl. std.	31.6	65.8	103	142	184
6	1½" std.	59.6	125	195	271	352
	2 ⁵ / ₁₆ " dbl. std.	35.9	74.8	117	162	210

a In Btu per hr per linear ft. b Courtesy of The Magnesia Insulation Mfgs. Association

Courtesy, North American Mfg. Co., 1956

Thermal Conductivity of Various Insulating Materials

Material	Description	Density per cu. ft.	Mean temp., F.	Thermal conduct- ivity	Authority
Air Cell Paper	Corrugated	8.74	86	0.494	Bur. of Stds.
Air Cell Pipe Covering	Asbestos Paper	10.76	158	0.718	McMillan
Asbestos	Fibre	23.9	122	0.798	Groeber
Asbestos	Long Fibre	18.3	50	0.499	Randolph
Asbestos Lumber	Asbestos and Cement	123.0	86	2.70	Bur. of Stds.
Asbestos Mill Board	Sheet	60.50	86	0.843	Bur. of Stds.
Asbestos Paper	Sheet	61.2	68	1.002	Taylor
Cork	Granulated	4.8	59	0.32	Biquard
Cork	Regranulated: 3/16 in.	8.1	90	0.31	Bur. of Stds.
Corkboard	Pure: No Added Binder	10.6	90	0.30	Bur. of Stds.
Corkboard	With Bituminous Binder	15.6	86	0.35	Bur. of Stds.
Diatomaceous Earth	Powder	10.6	86	0.30	Bur. of Stds.
Insulating Wool	Mineral Wool	8.00	103	0.27	Bur. of Stds.
Fire Felt	Asbestos Sheets	26.2	86	0.59	Bur. of Stds.
Fire Felt Pipe Covering	Asbestos Sheets	26.2	...	1.09	McMillan
Glass Wool	25 to 30 Microns	1.5	75	0.27	J. C. Peebles
Granulated Mineral Wool		4	100	.30	
Hair Felt	Felted Cattle Hair	11.0	90	0.26	Bur. of Stds.
Hairinsul	75% Hair, 25% Jute	6.3	90	0.27	Bur. of Stds.
Mineral Wool					
Insulating Cement		22	200	.54	
Loose Mineral Wool		8	100	.30	
Mineral Wool Blanket		12	100	.29	
Mineral Wool Block		22	200	.37	
Magnesia	85% MgO, 15% Asbestos	19.3	86	0.51	Bur. of Stds.
Red Top Wool	Glass Wool	1.5	75	0.27	J. C. Peebles
Rock Wool	Rock Wool with Binder	14.5	77	0.33	Bur. of Stds.
Rock Wool	Fibrous Material	14.0	90	0.28	Bur. of Stds.
Thermofill	Flaked Gypsum	26.0	90	0.52	Bur. of Stds.
Vitrobestos	Vitrified Air Cell	29.6	158	1.08	McMillan
Brick	Common, Machine Made	131.9	...	3.73 to 4.55	A. S. R. E.
Brick	Silicon Carbide	...	302	9.28	A. S. R. E.
Brick		...	2128	78.4	A. S. R. E.
Brick	Fire Clay	...	257	9.28	A. S. R. E.
Brick		...	2164	15.7	A. S. R. E.
Brick	Graphite	...	572	69.7	A. S. R. E.
Brick	Magnesia	...	122	7.84	A. S. R. E.
Brick		...	2003	20.9	A. S. R. E.
Concrete	Silica	...	212	5.8	A. S. R. E.
Gravel	Stone 1-2-4 mix	...	95	6.27	A. S. R. E.
Mortar	Loose-dry	115.5	68	2.58	A. S. R. E.
Sand	Portland Cement No. 1	107	191.5	2.33	A. S. R. E.
Wood	River	94.8	68	2.26	A. S. R. E.
Wood	White Pine	31.2	86	.784	Bur. of Stds.
Wood	Yellow Pine	...	91	1.03	A. S. R. E.
Wood	Oak	38	86	1.01	Bur. of Stds.
Aluminum		...	212	1050.0	A. S. R. E.
Copper	Pure	...	212	2547.0	A. S. R. E.
Brass	Yellow	...	212	738.0	A. S. R. E.
Brass	Red	...	212	820.0	A. S. R. E.
Iron	Cast	...	86	432.0	A. S. R. E.
Iron	Wrought	...	212	412.0	A. S. R. E.
Steel	1% Carbon	...	212	312.5	A. S. R. E.
Zinc	Pure	...	212	760	A. S. R. E.

Courtesy, The Eagle-Picher Co.
Checked 1956

Average Temperatures to Which Various Ceramic Products are Fired

Heavy Clay Products:	Temp. Deg. F.
Common brick—surface clay.....	1600-1800
Common brick—shale.....	1800-2000
Face brick—shale.....	1950-2200
Face brick—fire clay.....	2100-2300
Face brick—surface clay.....	1750-1850
Enamel brick.....	2100-2300
Paving brick (vitrified).....	2000-2250
Structural clay tile—surface clay.....	1600-1800
Structural clay tile—shale.....	1800-2000
Structural clay tile—fire clay.....	1950-2100
Drain tile.....	1700-1900
Sewer pipe.....	2030-2320
Roofing tile.....	1960-2140
Terra cotta.....	2070-2320

Pottery:	
Flower pots.....	1580-1850
Stoneware (chemical).....	2650-2700
Stoneware (once fired).....	2318-2426
Earthenware or semi-vitreous ware—bisque.....	2282-2354
Earthenware or semi-vitreous ware—glost.....	2174-2282
Art ware—bisque.....	2030-2426
Art ware—glost.....	1814-2426
Pottery decalcomanias.....	1400-1500

Refractories:	
Fire brick—clay.....	2300-2500
Bauxite brick.....	2650-2800
Fire brick—silica.....	2650-2750
Chrome brick.....	2650-2800
Magnesite brick.....	2650-2800
Silicon carbide.....	3236-3992

White Wares:	
Electrical porcelain.....	2390-2500
Hotel china—bisque.....	2390-2436
Hotel china—glost.....	2210-2282
Sanitary ware—bisque.....	2318-2426
Sanitary ware—glost.....	2246-2318
Floor tile.....	2318-2438
Wall tile—bisque.....	1886-2354
Wall tile—glost.....	1886-2246

Enamels:	
Wet process cast iron enamels....	1150-1400
Dry process cast iron enamels....	1550-1700
Sheet iron ground coat enamels....	1450-1650
Sheet iron cover coat enamels....	1400-1525
A-19 Coating.....	1800-1850
Solaramic.....	1800-1850

Checked 1956

Losses from Water Surfaces^a

	Water Temperature °F									
	170	175	180	185	190	195	200	205	210	
Liquid evaporated ^b	2.30	2.51	2.80	3.16	3.61	4.14	4.77	5.47	6.33	
	1.29	1.45	1.69	2.03	2.49	3.06	3.83	4.79	5.98	
Heat of evaporation ^c	2227	2432	2714	3065	3492	4021	4623	5307	6140	
	1248	1404	1637	1966	2407	2968	3714	4646	5802	
Heat to make-up water ^c	253	288	336	395	468	559	667	793	950	
	142	166	203	254	323	412	536	694	898	
Radiation and convection loss ^c	262	271	303	320	336	354	371	390	407	
	262	271	303	320	336	354	371	390	407	
Evaporation, Radiation, and Convection ^c	2489	2703	3017	3385	3828	4375	4994	5697	6547	
	1524	1675	1940	2286	2743	3322	4085	5036	6209	
Evaporation, Make-up, Radia- tion, and Con- vection ^c	2742	2991	3353	3780	4296	4934	5661	6490	7497	
	1666	1841	2143	2540	3066	3734	4621	5730	7107	

^aFigures in boldface type are for agitated liquids; others are for non-agitated liquids.
^bIn lb per hr per sq ft.
^cIn Btu per hr per sq ft.
 All data are based on a room temperature of 60°F and a make-up water temperature of 60°F.

Courtesy, North American Mfg. Co., 1956

Temperature Measurement

8

Millivolt-Temperature Conversions for Chromel to Alumel Thermocouples

Degrees F					Reference Junction Zero F								
F	0	100	200	300	400	500	600	700	800	900	1000	1100	1200
Millivolts.													
0	0	2.20	4.50	6.77	8.99	11.24	13.53	15.86	18.20	20.56	22.93	25.30	27.66
5	.10	2.31	4.61	6.88	9.10	11.35	13.64	15.97	18.31	20.68	23.05	25.42	27.78
10	.21	2.42	4.73	6.99	9.21	11.47	13.76	16.09	18.43	20.80	23.17	25.53	27.89
15	.31	2.53	4.84	7.10	9.32	11.58	13.87	16.20	18.55	20.92	23.28	25.65	28.01
20	.42	2.65	4.96	7.21	9.44	11.70	13.99	16.32	18.67	21.04	23.40	25.77	28.13
25	.53	2.76	5.07	7.32	9.55	11.81	14.11	16.44	18.78	21.15	23.52	25.89	28.25
30	.64	2.88	5.19	7.43	9.66	11.93	14.23	16.56	18.90	21.27	23.64	26.01	28.36
35	.75	2.99	5.30	7.54	9.77	12.04	14.35	16.68	19.02	21.39	23.76	26.13	28.48
40	.86	3.11	5.42	7.66	9.88	12.15	14.46	16.79	19.14	21.51	23.88	26.25	28.60
45	.97	3.22	5.55	7.77	9.99	12.26	14.57	16.91	19.26	21.63	24.00	26.37	28.72
50	1.08	3.34	5.65	7.88	10.11	12.38	14.69	17.03	19.38	21.75	24.11	26.48	28.83
55	1.19	3.45	5.76	7.99	10.23	12.49	14.80	17.15	19.49	21.85	24.23	26.60	28.95
60	1.30	3.57	5.87	8.10	10.34	12.61	14.92	17.26	19.61	21.98	24.35	26.72	29.07
65	1.41	3.68	5.98	8.21	10.45	12.72	15.04	17.38	19.73	22.10	24.47	26.84	29.19
70	1.52	3.80	6.10	8.32	10.56	12.84	15.16	17.50	19.85	22.22	24.59	26.95	29.30
75	1.63	3.92	6.21	8.43	10.67	12.95	15.28	17.61	19.97	22.34	24.70	27.07	29.42
80	1.74	4.04	6.32	8.55	10.79	13.07	15.39	17.73	20.09	22.46	24.82	27.19	29.54
85	1.85	4.16	6.43	8.66	10.90	13.18	15.51	17.85	20.20	22.57	24.94	27.31	29.66
90	1.97	4.27	6.55	8.77	11.01	13.30	15.62	17.97	20.32	22.69	25.06	27.42	29.77
95	2.08	4.38	6.66	8.88	11.12	13.41	15.74	18.08	20.44	22.81	25.18	27.54	29.89
100	2.20	4.50	6.77	8.99	11.24	13.53	15.86	18.20	20.56	22.93	25.30	27.66	30.01
*	.022	.023	.0227	.0222	.0225	.0229	.0233	.0234	.0236	.0237	.0237	.0236	.0235

F	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Millivolts.												
0	30.01	32.33	34.62	36.88	39.11	41.30	43.45	45.57	47.65	49.69	51.68	53.63
5	30.13	32.45	34.74	36.99	39.22	41.41	43.56	45.68	47.76	49.79	51.78	53.73
10	30.24	32.56	34.85	37.10	39.33	41.51	43.66	45.78	47.86	49.89	51.88	53.82
15	30.36	32.68	34.97	37.22	39.44	41.62	43.77	45.88	47.96	49.99	51.98	53.92
20	30.47	32.79	35.08	37.33	39.55	41.73	43.88	45.99	48.06	50.09	52.07	54.01
25	30.59	32.91	35.19	37.44	39.66	41.84	43.99	46.09	48.17	50.19	52.17	54.11
30	30.70	33.02	35.30	37.55	39.77	41.95	44.09	46.20	48.27	50.29	52.27	54.20
35	30.82	33.14	35.42	37.67	39.88	42.06	44.20	46.30	48.37	50.39	52.37	54.30
40	30.94	33.25	35.53	37.78	39.99	42.16	44.30	46.41	48.47	50.49	52.46	54.39
45	31.06	33.37	35.65	37.89	40.10	42.27	44.41	46.51	48.57	50.59	52.56	54.49
50	31.17	33.48	35.76	38.00	40.21	42.38	44.51	46.61	48.67	50.69	52.66	54.58
55	31.29	33.60	35.87	38.11	40.32	42.49	44.62	46.72	48.78	50.79	52.76	54.68
60	31.40	33.71	35.98	38.22	40.43	42.59	44.72	46.82	48.88	50.89	52.85	54.77
65	31.52	33.83	36.10	38.33	40.54	42.70	44.83	46.93	48.98	50.99	52.95	54.87
70	31.64	33.94	36.21	38.44	40.64	42.81	44.94	47.03	49.08	51.09	53.05	54.96
75	31.76	34.06	36.32	38.56	40.75	42.92	45.05	47.14	49.19	51.19	53.15	55.06
80	31.87	34.17	36.43	38.67	40.86	43.02	45.15	47.24	49.29	51.29	53.24	55.15
85	31.99	34.28	36.55	38.78	40.97	43.13	45.26	47.34	49.39	51.39	53.34	55.25
90	32.10	34.39	36.66	38.89	41.08	43.24	45.36	47.44	49.49	51.48	53.43	55.34
95	32.22	34.51	36.77	39.00	41.19	43.35	45.47	47.55	49.59	51.58	53.53	55.44
100	32.33	34.62	36.88	39.11	41.30	43.45	45.57	47.65	49.69	51.68	53.63	55.53
*	.0232	.0229	.0226	.0223	.0219	.0215	.0212	.0208	.0204	.0199	.0195	.0190

*Average millivolts per degree F

Millivolt-Temperature Conversions for 90% Platinum, 10% Rhodium to Platinum Thermocouples

		Degrees F					Reference Junction Zero F									
F	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
Millivolts.																
0	0	.313	.687	1.108	1.565	2.048	2.549	3.067	3.597	4.136	4.686	5.247	5.817	6.399	6.990	7.592
5	.014	.331	.707	1.130	1.589	2.072	2.574	3.093	3.624	4.163	4.713	5.275	5.846	6.428	7.020	7.622
10	.028	.349	.727	1.152	1.613	2.097	2.600	3.120	3.651	4.190	4.741	5.303	5.875	6.458	7.050	7.653
15	.043	.366	.747	1.174	1.636	2.122	2.626	3.146	3.677	4.217	4.769	5.331	5.904	6.487	7.079	7.683
20	.057	.384	.768	1.197	1.660	2.147	2.652	3.173	3.704	4.245	4.797	5.360	5.933	6.516	7.109	7.713
25	.071	.402	.788	1.219	1.684	2.172	2.677	3.199	3.731	4.272	4.825	5.388	5.961	6.545	7.139	7.743
30	.086	.420	.809	1.242	1.708	2.197	2.703	3.225	3.759	4.300	4.853	5.416	5.990	6.575	7.169	7.774
35	.101	.438	.829	1.265	1.732	2.222	2.729	3.251	3.786	4.327	4.881	5.444	6.019	6.604	7.199	7.805
40	.116	.457	.850	1.288	1.756	2.247	2.755	3.278	3.812	4.355	4.909	5.473	6.048	6.634	7.229	7.836
45	.132	.475	.871	1.310	1.780	2.272	2.781	3.304	3.839	4.382	4.937	5.501	6.077	6.663	7.259	7.866
50	.148	.493	.892	1.333	1.804	2.297	2.807	3.331	3.866	4.410	4.965	5.530	6.107	6.693	7.290	7.897
55	.164	.512	.913	1.356	1.828	2.322	2.833	3.358	3.893	4.437	4.993	5.558	6.136	6.722	7.320	7.927
60	.180	.531	.935	1.379	1.852	2.347	2.859	3.385	3.920	4.465	5.021	5.587	6.165	6.752	7.350	7.958
65	.196	.550	.956	1.402	1.876	2.372	2.885	3.411	3.947	4.492	5.049	5.616	6.194	6.782	7.380	7.989
70	.212	.569	.978	1.425	1.900	2.397	2.911	3.438	3.974	4.520	5.077	5.645	6.224	6.812	7.410	8.020
75	.229	.588	.999	1.448	1.924	2.422	2.937	3.464	4.001	4.547	5.105	5.673	6.263	6.841	7.440	8.050
80	.245	.608	1.021	1.472	1.949	2.448	2.963	3.491	4.028	4.575	5.134	5.702	6.282	6.871	7.471	8.081
85	.262	.627	1.042	1.495	1.973	2.473	2.989	3.517	4.055	4.603	5.162	5.730	6.311	6.900	7.501	8.112
90	.279	.647	1.064	1.518	1.998	2.498	3.015	3.544	4.082	4.631	5.190	5.759	6.341	6.930	7.531	8.143
95	.296	.667	1.086	1.541	2.023	2.523	3.041	3.570	4.109	4.658	5.218	5.788	6.370	6.960	7.561	8.173
100	.313	.687	1.108	1.565	2.048	2.549	3.067	3.597	4.136	4.686	5.247	5.817	6.399	6.990	7.592	8.204
*	.00313	.00374	.00421	.00457	.00483	.00501	.00518	.00530	.00539	.00550	.00561	.00570	.00582	.00591	.00602	.00612
F	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100
Millivolts.																
0	8.204	8.826	9.457	10.099	10.749	11.408	12.069	12.734	13.397	14.060	14.721	15.380	16.035	16.688	17.339	17.984
5	8.235	8.857	9.489	10.131	10.782	11.441	12.102	12.767	13.431	14.093	14.754	15.413	16.068	16.721	17.371	18.017
10	8.266	8.888	9.521	10.163	10.815	11.474	12.135	12.800	13.464	14.126	14.787	15.445	16.101	16.753	17.403	18.049
15	8.297	8.919	9.553	10.195	10.848	11.507	12.168	12.833	13.497	14.159	14.820	15.478	16.133	16.786	17.436	18.081
20	8.328	8.951	9.585	10.228	10.881	11.540	12.202	12.867	13.530	14.192	14.853	15.510	16.166	16.818	17.468	18.113
25	8.359	8.982	9.617	10.260	10.914	11.573	12.235	12.900	13.564	14.225	14.886	15.543	16.199	16.851	17.500	—
30	8.390	9.014	9.649	10.293	10.947	11.606	12.269	12.933	13.597	14.258	14.918	15.576	16.231	16.883	17.532	—
35	8.421	9.045	9.681	10.325	10.979	11.639	12.302	12.966	13.630	14.292	14.951	15.609	16.264	16.916	17.565	—
40	8.452	9.077	9.713	10.358	11.012	11.672	12.335	12.999	13.663	14.325	14.984	15.642	16.297	16.948	17.597	—
45	8.483	9.108	9.745	10.390	11.045	11.705	12.368	13.033	13.696	14.358	15.017	15.675	16.329	16.981	17.630	—
50	8.514	9.140	9.777	10.423	11.078	11.738	12.402	13.066	13.729	14.391	15.050	15.707	16.362	17.014	17.662	—
55	8.545	9.171	9.809	10.455	11.111	11.771	12.435	13.099	13.762	14.424	15.083	15.740	16.395	17.047	17.694	—
60	8.576	9.203	9.841	10.488	11.144	11.804	12.468	13.132	13.795	14.457	15.116	15.772	16.427	17.079	17.726	—
65	8.607	9.235	9.873	10.520	11.177	11.837	12.501	13.166	13.829	14.490	15.149	15.805	16.460	17.112	17.759	—
70	8.638	9.267	9.905	10.553	11.210	11.870	12.534	13.199	13.862	14.523	15.182	15.838	16.493	17.144	17.791	—
75	8.669	9.298	9.937	10.585	11.243	11.903	12.567	13.232	13.895	14.556	15.215	15.871	16.525	17.177	17.823	—
80	8.701	9.330	9.969	10.618	11.276	11.936	12.601	13.265	13.928	14.589	15.248	15.904	16.558	17.209	17.855	—
85	8.732	9.362	10.002	10.650	11.309	11.969	12.634	13.298	13.961	14.622	15.281	15.937	16.590	17.242	17.888	—
90	8.763	9.394	10.034	10.683	11.342	12.003	12.667	13.331	13.994	14.655	15.314	15.970	16.623	17.274	17.920	—
95	8.794	9.425	10.066	10.716	11.375	12.036	12.700	13.364	14.027	14.688	15.347	16.003	16.656	17.307	17.952	—
100	8.826	9.457	10.099	10.749	11.408	12.069	12.734	13.397	14.060	14.721	15.380	16.035	16.688	17.339	17.984	—
*	.00622	.00631	.00642	.00650	.00659	.00661	.00665	.00663	.00663	.00661	.00659	.00655	.00653	.00651	.00645	.00645

*Average millivolts per degree F

Millivolt-Temperature Conversions for Copper to Constantan Thermocouples

		Degrees F				Reference Junction Zero F							
F	mv	F	mv	F	mv	F	mv	F	mv	F	mv	F	mv
0	0	100	2.19	200	4.64	300	7.31	400	10.19	500	13.24	600	16.44
2	.04	102	2.23	202	4.69	302	7.37	402	10.25	502	13.30	602	16.50
4	.08	104	2.28	204	4.74	304	7.43	404	10.31	504	13.37	604	16.57
6	.12	106	2.33	206	4.79	306	7.48	406	10.37	506	13.43	606	16.63
8	.16	108	2.37	208	4.84	308	7.54	408	10.43	508	13.49	608	16.70
10	.21	110	2.42	210	4.89	310	7.59	410	10.49	510	13.56	610	16.77
12	.25	112	2.47	212	4.95	312	7.65	412	10.55	512	13.62	612	16.83
14	.29	114	2.51	214	5.00	314	7.71	414	10.61	514	13.68	614	16.90
16	.33	116	2.56	216	5.05	316	7.76	416	10.67	516	13.74	616	16.96
18	.37	118	2.61	218	5.10	318	7.82	418	10.73	518	13.81	618	17.03
20	.42	120	2.66	220	5.15	320	7.88	420	10.79	520	13.87	620	17.09
22	.46	122	2.70	222	5.21	322	7.93	422	10.85	522	13.93	622	17.16
24	.50	124	2.75	224	5.26	324	7.99	424	10.91	524	14.00	624	17.23
26	.54	126	2.80	226	5.31	326	8.05	426	10.97	526	14.06	626	17.29
28	.58	128	2.85	228	5.36	328	8.10	428	11.03	528	14.12	628	17.36
30	.63	130	2.90	230	5.42	330	8.16	430	11.09	530	14.19	630	17.42
32	.67	132	2.94	232	5.47	332	8.22	432	11.15	532	14.25	632	17.49
34	.71	134	2.99	234	5.52	334	8.27	434	11.21	534	14.31	634	17.56
36	.76	136	3.04	236	5.58	336	8.33	436	11.27	536	14.38	636	17.62
38	.80	138	3.09	238	5.63	338	8.39	438	11.33	538	14.44	638	17.69
40	.84	140	3.14	240	5.68	340	8.44	440	11.39	540	14.50	640	17.75
42	.89	142	3.19	242	5.74	342	8.50	442	11.45	542	14.57	642	17.82
44	.93	144	3.23	244	5.79	344	8.56	444	11.51	544	14.63	644	17.89
46	.97	146	3.28	246	5.84	346	8.62	446	11.57	546	14.69	646	17.95
48	1.02	148	3.33	248	5.90	348	8.67	448	11.64	548	14.76	648	18.02
50	1.06	150	3.38	250	5.95	350	8.73	450	11.70	550	14.82	650	18.09
52	1.10	152	3.43	252	6.00	352	8.79	452	11.76	552	14.89	652	18.15
54	1.15	154	3.48	254	6.06	354	8.85	454	11.82	554	14.95	654	18.22
56	1.19	156	3.53	256	6.11	356	8.90	456	11.88	556	15.01	656	18.29
58	1.24	158	3.58	258	6.16	358	8.96	458	11.94	558	15.08	658	18.35
60	1.28	160	3.63	260	6.22	360	9.02	460	12.00	560	15.14	660	18.42
62	1.32	162	3.68	262	6.27	362	9.08	462	12.06	562	15.21	662	18.49
64	1.37	164	3.73	264	6.33	364	9.14	464	12.12	564	15.27	664	18.55
66	1.41	166	3.78	266	6.38	366	9.19	466	12.19	566	15.33	666	18.62
68	1.46	168	3.83	268	6.43	368	9.25	468	12.25	568	15.40	668	18.69
70	1.50	170	3.88	270	6.49	370	9.31	470	12.31	570	15.46	670	18.75
72	1.55	172	3.93	272	6.54	372	9.37	472	12.37	572	15.53	672	18.82
74	1.59	174	3.98	274	6.60	374	9.43	474	12.43	574	15.59	674	18.89
76	1.64	176	4.03	276	6.65	376	9.48	476	12.49	576	15.66	676	18.95
78	1.68	178	4.08	278	6.71	378	9.54	478	12.56	578	15.72	678	19.02
80	1.73	180	4.13	280	6.76	380	9.60	480	12.62	580	15.79	680	19.09
82	1.77	182	4.18	282	6.82	382	9.66	482	12.68	582	15.85	682	19.16
84	1.82	184	4.23	284	6.87	384	9.72	484	12.74	584	15.92	684	19.22
86	1.86	186	4.28	286	6.93	386	9.78	486	12.80	586	15.98	686	19.29
88	1.91	188	4.33	288	6.98	388	9.84	488	12.87	588	16.05	688	19.36
90	1.96	190	4.38	290	7.04	390	9.90	490	12.93	590	16.11	690	19.42
92	2.00	192	4.43	292	7.09	392	9.96	492	12.99	592	16.18	692	19.49
94	2.05	194	4.48	294	7.15	394	10.01	494	13.05	594	16.24	694	19.56
96	2.09	196	4.53	296	7.20	396	10.07	496	13.12	596	16.31	696	19.63
98	2.14	198	4.58	298	7.26	398	10.13	498	13.18	598	16.37	698	19.69
100	2.19	200	4.64	300	7.31	400	10.19	500	13.24	600	16.44	700	19.76
.022*		.025*		.027*		.029*		.031*		.032*		.033*	

*Average millivolts per degree F

Courtesy, The Babcock & Wilcox Co., 1956

Millivolt-Temperature Conversions for Iron to Constantan Thermocouples

Degrees F												
Reference Junction Zero F												
F	0	100	200	300	400	500	600	700	800	900	1000	1100
Millivolts.												
0	0	2.88	5.84	8.87	11.94	15.01	18.08	21.15	24.23	27.33	30.46	33.66
5	1.44	3.03	5.99	9.02	12.09	15.16	18.23	21.30	24.38	27.49	30.62	33.82
10	.288	3.18	6.14	9.18	12.24	15.32	18.39	21.46	24.54	27.64	30.78	33.99
15	.432	3.32	6.29	9.33	12.40	15.47	18.54	21.61	24.69	27.80	30.94	34.15
20	.576	3.47	6.45	9.48	12.55	15.62	18.69	21.77	24.85	27.96	31.10	34.32
25	.720	3.62	6.60	9.64	12.71	15.78	18.85	21.92	25.00	28.11	31.26	34.48
30	.864	3.77	6.75	9.79	12.86	15.93	19.00	22.07	25.16	28.27	31.42	34.65
35	1.01	3.92	6.90	9.94	13.01	16.08	19.15	22.23	25.31	28.42	31.58	34.81
40	1.15	4.06	7.05	10.10	13.17	16.24	19.31	22.38	25.47	28.58	31.74	34.98
45	1.30	4.21	7.20	10.25	13.32	16.39	19.46	22.54	25.62	28.74	31.90	35.14
50	1.44	4.36	7.36	10.40	13.47	16.54	19.61	22.69	25.78	28.89	32.06	35.31
55	1.58	4.51	7.50	10.56	13.63	16.70	19.77	22.84	25.93	29.05	32.22	35.47
60	1.73	4.66	7.66	10.71	13.78	16.85	19.92	23.00	26.09	29.21	32.38	35.64
65	1.87	4.80	7.81	10.86	13.94	17.00	20.07	23.15	26.24	29.36	32.54	35.80
70	2.02	4.95	7.96	11.02	14.09	17.16	20.23	23.31	26.40	29.52	32.70	35.97
75	2.16	5.10	8.11	11.17	14.24	17.31	20.38	23.46	26.55	29.68	32.86	36.13
80	2.30	5.25	8.26	11.32	14.40	17.47	20.54	23.61	26.71	29.83	33.02	36.30
85	2.45	5.40	8.42	11.47	14.55	17.62	20.69	23.77	26.86	29.99	33.18	36.46
90	2.59	5.54	8.57	11.63	14.70	17.77	20.84	23.92	27.02	30.15	33.34	36.63
95	2.74	5.69	8.72	11.78	14.86	17.93	21.00	24.08	27.17	30.30	33.50	36.79
100	2.88	5.84	8.87	11.94	15.01	18.08	21.15	24.23	27.33	30.46	33.66	36.96
*	.0288	.0296	.0303	.0307	.0307	.0307	.0307	.0308	.0310	.0313	.0320	.033

F	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100
Millivolts.										
0	36.96	40.38	43.88	47.40	50.92	54.44	57.96	61.48	65.00	68.52
5	37.13	40.56	44.06	47.58	51.10	54.62	58.14	61.66	65.18	68.70
10	37.30	40.73	44.23	47.75	51.27	54.79	58.31	61.83	65.35	68.87
15	37.47	40.90	44.41	47.93	51.45	54.97	58.49	62.01	65.53	69.05
20	37.64	41.08	44.58	48.10	51.62	55.14	58.66	62.18	65.70	69.22
25	37.81	41.26	44.76	48.28	51.80	55.32	58.84	62.36	65.88	69.40
30	37.99	41.43	44.94	48.46	51.98	55.50	59.02	62.54	66.06	69.58
35	38.16	41.60	45.11	48.63	52.15	55.67	59.19	62.71	66.23	69.75
40	38.33	41.78	45.29	48.81	52.33	55.85	59.37	62.89	66.41	69.93
45	38.50	41.95	45.46	48.98	52.50	56.02	59.54	63.06	66.58	70.10
50	38.67	42.13	45.64	49.16	52.68	56.20	59.72	63.24	66.76	70.28
55	38.84	42.30	45.82	49.34	52.86	56.38	59.90	63.42	66.94	70.46
60	39.01	42.48	45.99	49.51	53.03	56.55	60.07	63.59	67.11	70.63
65	39.18	42.65	46.17	49.69	53.21	56.73	60.25	63.77	67.29	70.81
70	39.35	42.83	46.34	49.86	53.38	56.90	60.42	63.94	67.46	70.98
75	39.52	43.00	46.52	50.04	53.56	57.08	60.60	64.12	67.64	71.16
80	39.70	43.18	46.70	50.22	53.74	57.26	60.78	64.30	67.82	71.34
85	39.87	43.35	46.87	50.39	53.91	57.43	60.95	64.47	67.99	71.51
90	40.04	43.53	47.05	50.57	54.09	57.61	61.13	64.65	68.17	71.69
95	40.21	43.70	47.22	50.74	54.26	57.78	61.30	64.82	68.34	71.86
100	40.38	43.88	47.40	50.92	54.44	57.96	61.48	65.00	68.52	72.04
*	.0342	.0350	.0352	.0352	.0352	.0352	.0352	.0352	.0352	.0352

*Average millivolts per degree F

Temperature Equivalents Orton Standard Pyrometric Cones

CONE NUMBER	LARGE CONES				SMALL CONES		CONE NUMBER	P. C. E. CONES	
	(1) 60°C	108°F	150°C	270°F	300°C	540°F		150°C	270°F
022	585°C.	1085°F.	600°C.	1112°F.			12	1337°C.	2439°F.
021	602	1116	614	1137	643°C.	1189°F.	13	1349	2460
							14	1398	2548
020	625	1157	635	1175	666	1231	15	1430	2606
019	668	1234	683	1261	723	1333			
018	696	1285	717	1323	752	1386	16	1491	2716
017	727	1341	747	1377	784	1443	17	1512	2754
016	767	1407	792	1458	825	1517	18	1522	2772
							19	1541	2806
015	790	1454	804	1479	843	1549	20	1564	2847
014	834	1533	838	1540					
013	869	1596	852	1566			23	1605	2921
012	866	1591	884	1623			26	1621	2950
011	886	1627	894	1641			27	1640	2984
							28	1646	2995
010	887	1629	894	1641	919	1686	29	1659	3018
09	915	1679	923	1693	955	1751			
08	945	1733	955	1751	983	1801	30	1665	3029
07	973	1783	984	1803	1008	1846	31	1683	3061
06	991	1816	999	1830	1023	1873	31½	1699	3090
							32	1717	3123
05	1031	1888	1046	1915	1062	1944	32½	1724	3135
04	1050	1922	1060	1940	1098	2008			
03	1086	1987	1101	2014	1131	2068	33	1743	3169
02	1101	2014	1120	2048	1148	2098	34	1763	3205
01	1117	2043	1137	2079	1178	2152	35	1785	3245
							36	1804	3279
1	1136	2077	1154	2109	1179	2154	37	1820	3308
2	1142	2088	1162	2124	1179	2154			
3	1152	2106	1168	2134	1196	2185	38	1850*	3362
4	1168	2134	1186	2167	1209	2208	39	1865*	3389
5	1177	2151	1196	2185	1221	2230	40	1885*	3425
							41	1970*	3578
6	1201	2194	1222	2232	1255	2291	42	2015*	3659
7	1215	2219	1240	2264	1264	2307			
8	1236	2257	1263	2305	1300	2372			
9	1260	2300	1280	2336	1317	2403			
10	1285	2345	1305	2381	1330	2426			
11	1294	2361	1315	2399	1336	2437			
12	1306	2383	1326	2419	1355	2471			
13	1321	2410	1346	2455					
14	1388	2530	1366	2491					
15	1424	2595	1431	2608					
16	1455	2651	1473	2683					
17	1477	2691	1485	2705					
18	1500	2732	1506	2743					
19	1520	2768	1528	2782					
20	1542	2808	1549	2820					
23	1586	2887	1590	2894					
26	1589	2892	1605	2921					
27	1614	2937	1627	2961					
28	1614	2937	1633	2971					
29	1624	2955	1645	2993					
30	1636	2977	1654	3009					
31	1661	3022	1679	3054					
32	1706	3103	1717	3123					
32½	1718	3124	1730	3146					
33	1732	3150	1741	3166					
34	1757	3195	1759	3198					
35	1784	3243	1784	3243					
36	1798	3268	1796	3265					

(1) The rate of heating up the cones during the last several hundred degrees of the tests.

Note 1. All temperature equivalent values given in °C are average values as determined at the National Bureau of Standards and were measured at the time that the tip of the cone touched the plaque. All temperatures given in °F were calculated by the use of the following equation: $F = 1.8 \times C + 32$. Temperature equivalents were not determined for Small Cones Nos. 022, 014, 013, 012, and 011. The temperature equivalent values in °C shown in the table (except as noted) were determined by Henry P. Beerman, Research Associate, at the National Bureau of Standards for The Edward Orton Jr. Ceramic Foundation.

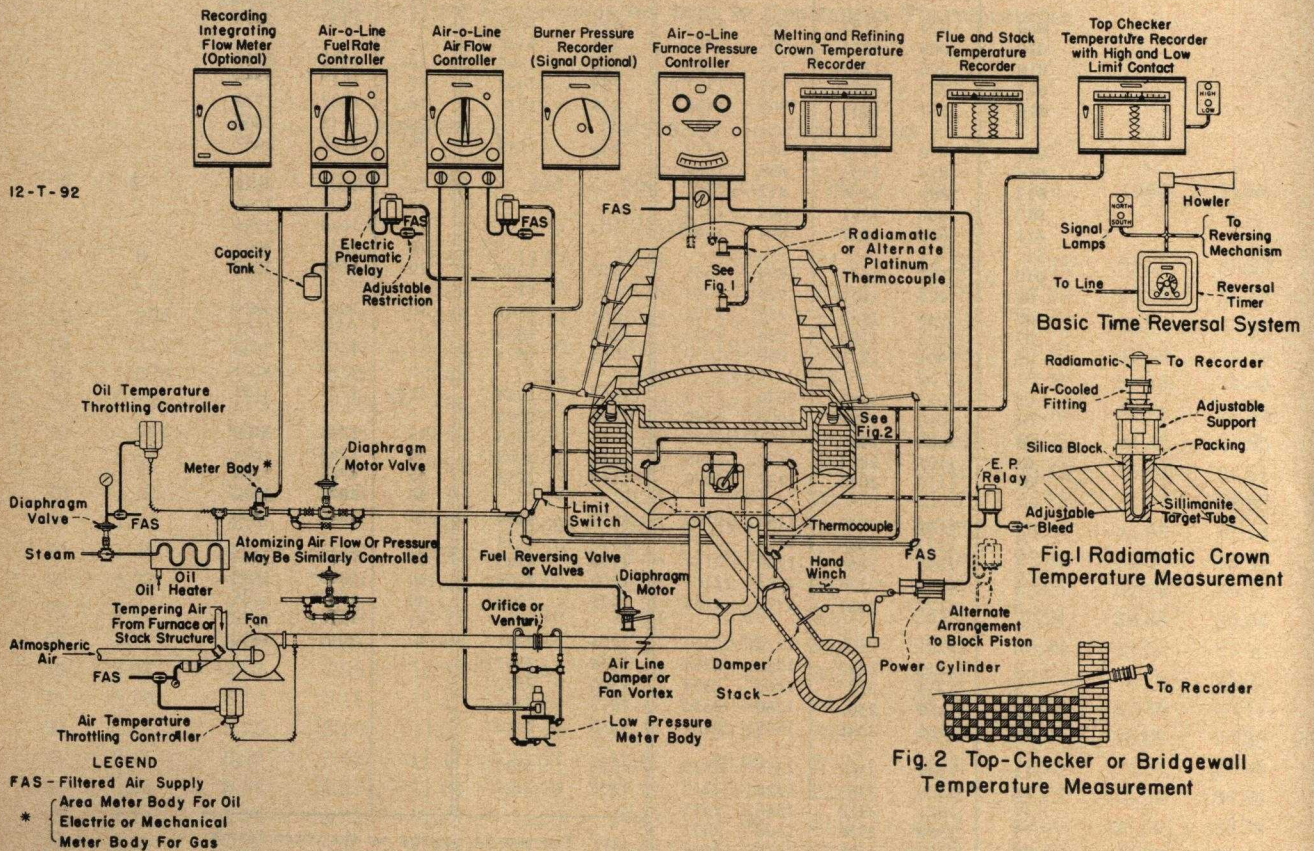
Note No. 2. The temperature equivalent values given in this table apply only to Orton Standard Pyrometric Cones when heated in an air atmosphere at the rate of heating shown. The temperature equivalent values are furnished for information purposes only. They are not necessarily the temperature actually in a furnace at the time when the cone goes down.

*See Fairchild and Peters, "Characteristics of Pyrometric Cones," Jour. Amer. Cer. Soc., Vol. 9, No. 11 p. 700 (1926) Cones Nos. 39-42, incl. were heated at a rate of 600 deg. C. per hour.

Courtesy, Edward Orton Jr. Ceramic Foundation

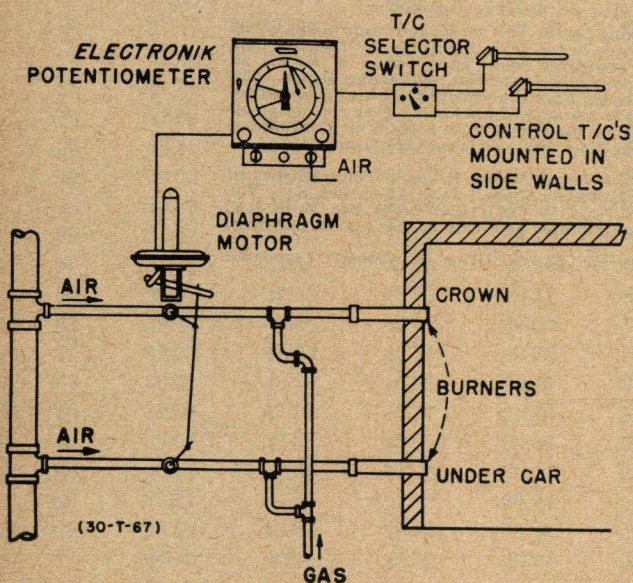
Heat Control

Glass Tank Instrumentation



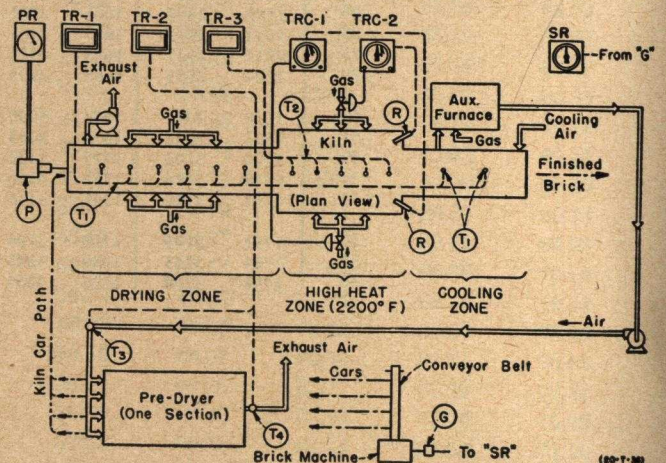
Courtesy, Minneapolis-Honeywell Regulator Co.
Checked 1956

Temperature Control System



Courtesy, Minneapolis-Honeywell Regulator Co.
Checked 1956

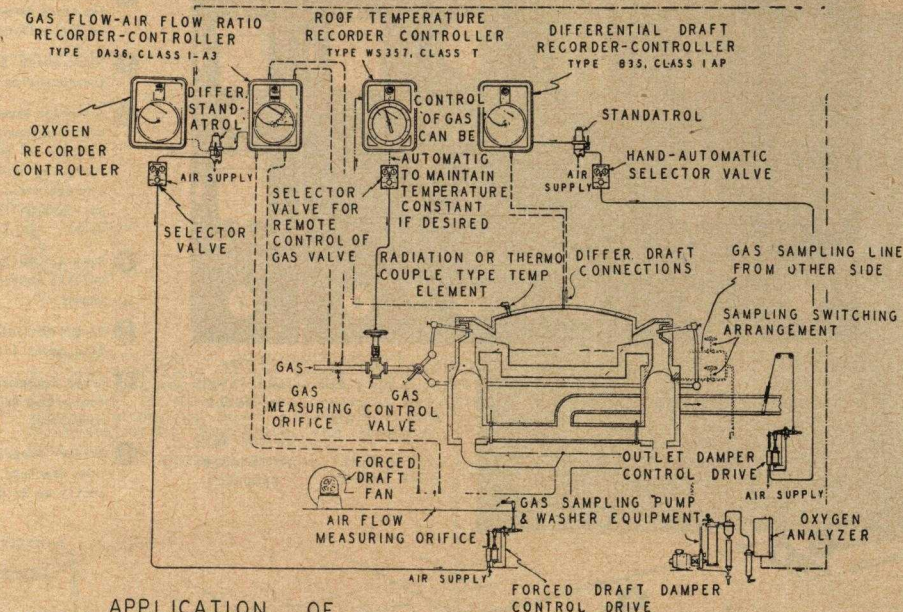
Instrumentation for Kiln and One Predryer Section



Schematic diagram of instrumentation for one kiln and one predryer section (duplicated on two other kilns and predryer sections) at Burns Brick Co., Macon, Ga. TR-1 Drying and cooling zone multi-point temperature recorder; TR-2—Predryer inlet and outlet temperature recorder (for all sections); TR-3—High-heat zone multi-point temperature recorder; TRC—Recording pneumatic temperature controller for heat zone; SR—Brick machine production recorder; PR—Kiln car pusher hydraulic pressure recorder; T1—Base metal thermocouples in kiln crown (drying and cooling); T2—Noble metal thermocouples in kiln crown; T3—Dry bulb thermocouple for inlet air to predryer; T4—Wet and dry bulb thermocouple assembly for exit air from predryer; P—Hydraulic car pusher mechanism; R—Radiomatic detecting element; G—Tachometer generator for speed measurement; — — — — T/c extension wire.

Courtesy, Minneapolis-Honeywell Regulator Co.
Checked 1956

Instrumentation of Regenerative Glass Tank



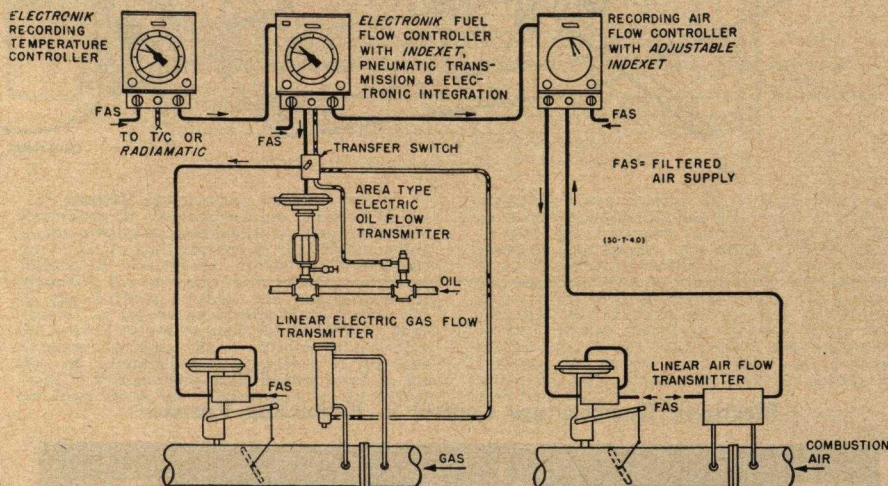
APPLICATION OF BAILEY METERING & CONTROL EQUIPMENT FOR REGENERATIVE GLASS FURNACE

This diagram shows the application of controls to a glass tank. Temperature is measured in the tank roof. Tank temperature can be kept constant or limited by a maximum value through automatic controller. Differential draft connections are in the roof and automatically control damper. Gas is automatically analyzed and oxygen recorded. This is connected with the gas-air ratio recorder controller which exerts control on the air supply and gas supply. Air and gas flow is recorded.

This system can be automatic but has manual control where manual changes may be advisable if desired.

Courtesy, Bailey Meter Co.
Checked 1956

Fuel-Air Ratio Control System

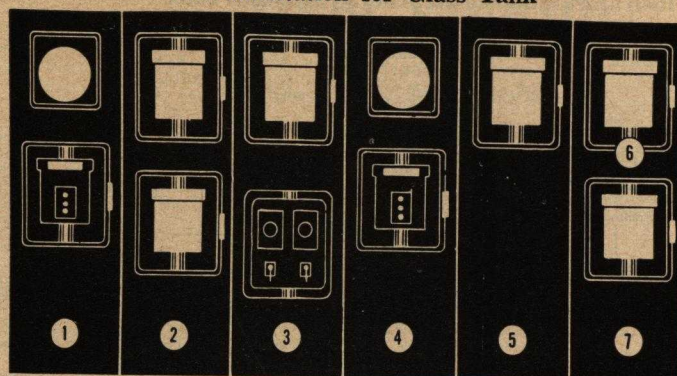


Metered air-to-fuel ratio control system for furnaces using alternate fuels—The instrument at the left, an ElectroniK Air-O-Line temperature controller actuated by a thermocouple or a Radiamatic unit at the furnace, automatically positions the set point index of the ElectroniK fuel flow controller, maintaining proper furnace temperature as well as the required fuel-air ratio. A pneumatically positioned Fixed Indexet unit in the fuel flow controller establishes the required fuel valve setting. The actual resultant fuel flow positions an Adjustable Indexet unit in the recording air flow controller. The fuel-air ratio is set by adjusting the ratio setting knob of the Adjustable Indexet, and air-to-fuel bias may be secured by means of a second knob in the ratio controller.

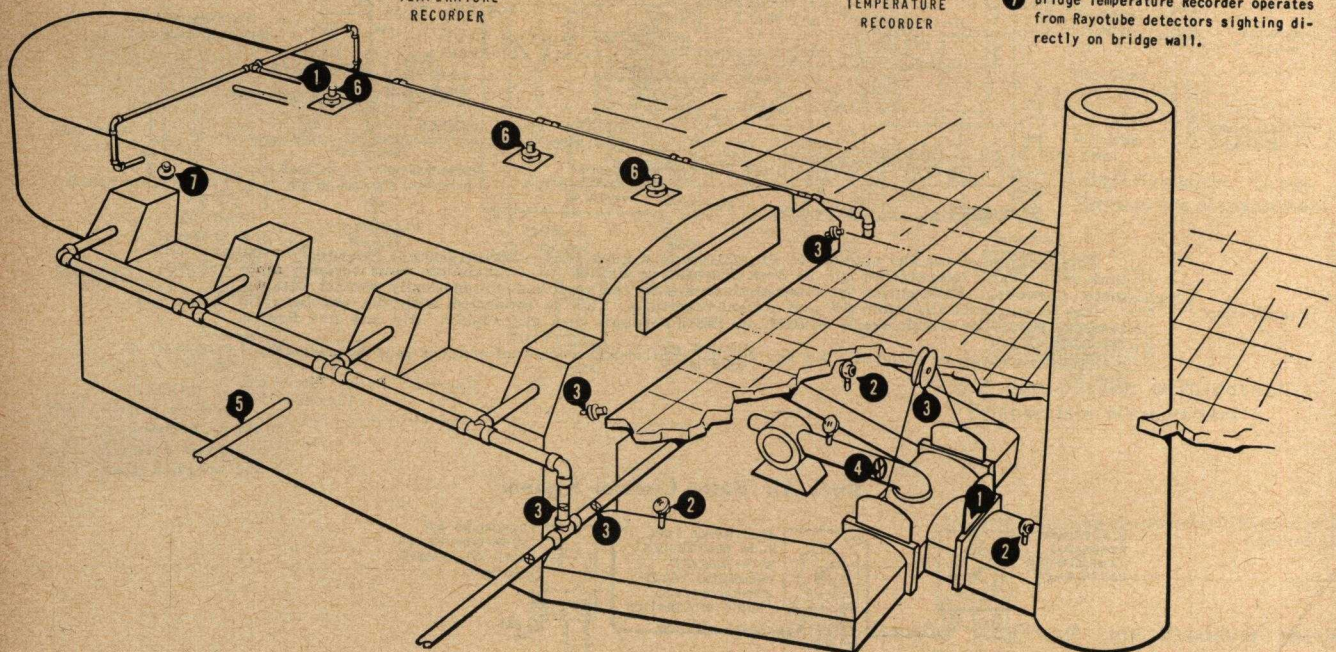
A linear flow transmitter measures the flow of air to the burner. Its transmitted air pressure goes to the recording air flow controller, and the Air-O-Line unit in this instrument provides the proper air pressure to operate the air supply control valve. An area type electric flow transmitter measures the fuel oil flow, and a linear electric transmitter measures gas flow. By use of the pneumatic and electric transfer switches, which are mechanically interlocked, signals from either transmitter may be sent to the fuel flow recorder-controller. This instrument, which incorporates an Air-O-Line unit, will send control air pressure to the air-to-valve line opened by the switch. The fuel flow controller also automatically integrates fuel flow.

Courtesy, Minneapolis-Honeywell Regulator Co.
Checked 1956

Instrumentation for Glass Tank

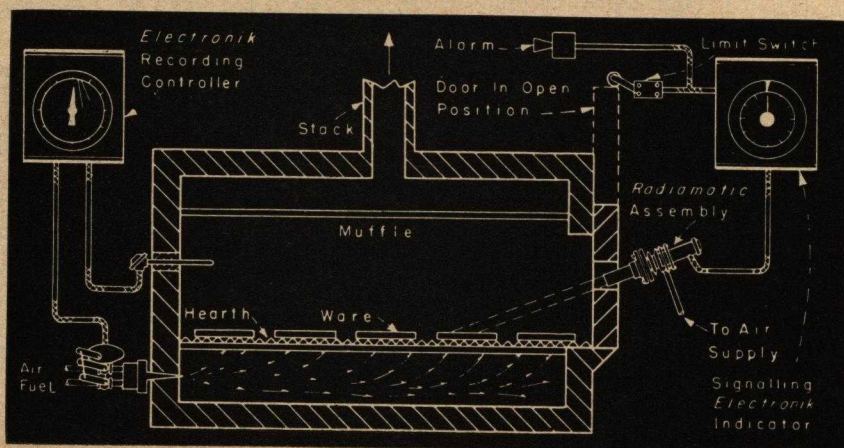
FURNACE
PRESSURE
CONTROLFLUE &
STACK
RECORDERAUTOMATIC
REVERSAL
CONTROLFUEL-AIR
RATIO
CONTROLOXYGEN
RECORDERCROWN
TEMPERATURE
RECORDERMISC.
TEMPERATURE
RECORDERBRIDGE WALL
TEMPERATURE
RECORDER

- 1 Furnace Pressure Controller operates the stack damper from average pressure in the melting zone.
- 2 Three-point Recorder operates from thermocouples in flues and stack.
- 3 Automatic Reversal Control System Operates from Rayotube detectors sighting on tops of checkers. Includes the following modes of reversal: time, temperature-difference, time or temperature-difference, or high temperature.
- 4 Fuel-Air Ratio Control automatically adjusts combustion air to follow fuel input.
- 5 Oxygen Recorder continuously analyzes flue gases for O_2 content.
- 6 Crown Temperature Recorder operates from either Rayotube detectors or thermocouples.
- 7 Bridge Temperature Recorder operates from Rayotube detectors sighting directly on bridge wall.



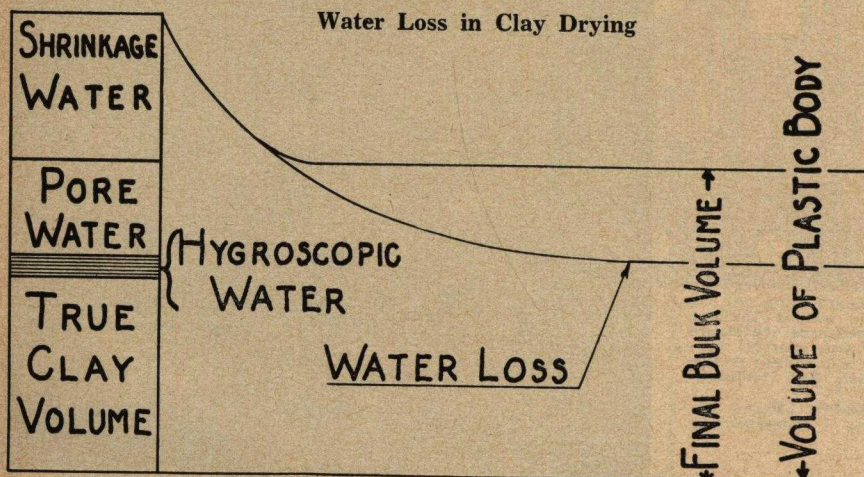
Courtesy, Leeds & Northrup Co.
Checked 1956

Electronic Temperature Control in Enameling Furnace



Courtesy, Minneapolis-Honeywell Regulator Co.
Checked 1956

Drying Data



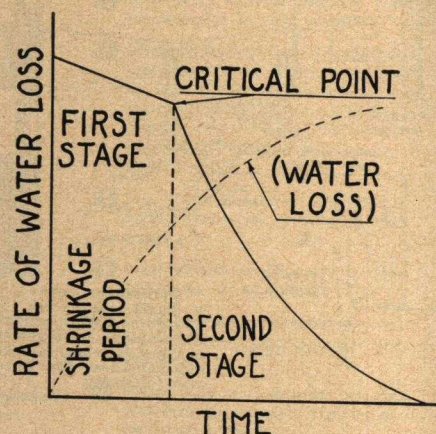
The total height of the box on the left of the above diagram represents the total volume of any plastic body. Reading from top to bottom, in drying, the shrinkage water is lost and the bulk volume is represented by the rest of the box, which is the final bulk volume. After this point has been reached the piece does not undergo any more shrinkage in drying, even though the pore water and hygroscopic water are driven off. The curve represents the total water loss.

SHRINKAGE WATER—That part of the free water which is removed during shrinkage.

PORE WATER—The free water remaining in the mass after shrinkage has ceased.

HYGROSCOPIC WATER—The water which can only be removed at elevated temperatures. It depends upon the amount of water present in the surroundings.

CHEMICALLY COMBINED WATER—The water which can be driven off only at temperatures above those normally used in drying.



The above diagram indicates the initial stage of drying, in which the rate of water loss is controlled by atmospheric conditions only, and the second or final stage, in which the rate of loss is controlled by the characteristics of the body, in addition to the atmospheric conditions. The critical point indicates the maximum limit of surface shrinkage due to drying.

(Charts on Following Pages)
Explanation and Use of
Psychrometric Charts

The psychrometric charts on the following pages have been prepared to show the various properties of air when the dry and wet bulb temperatures are known. On sheets 1 and 2 the dry bulb or actual air temperature is indicated by the horizontal distance from the left hand margin. The diagonal lines represent constant wet bulb temperatures and the curves represent a certain degree of relative humidity. At any point where a vertical line of constant dry-bulb temperature crosses a diagonal line representing a given wet-bulb temperature the per cent relative humidity can be determined by the proportionate distance of this point from the two adjacent relative humidity lines.

The following example will demonstrate the method of obtaining the desired properties of air: For a dry bulb temperature of 93 deg. F. and wet bulb temperature of 87 deg. F., follow the dotted lines, on sheet 1, from (t_a) and (t_w) for these temperatures to the intersection at (x). This point lies between the 70 per cent and 80 per cent relative humidity lines and indicates about 78 per cent. Following the dash line horizontally from (x), the weight of vapor per pound of dry air is indicated as 0.0266

lb. A mixture in this proportion is saturated at 85.4 deg. F., indicated by point (t_s) on the 100 per cent relative humidity line. From this point follow the dash line vertically to point (y) on the volume curve and then read the volume of saturated mixture containing one pound of dry air as 14.32 cu. ft. (For temperatures above 80.5 deg. F. (the peak in the volume curve) volume readings increase in a downward direction on the chart.) Sheet 2 is an extension of sheet 1.

Two volume curves are shown on the psychrometric chart, but it is necessary to make temperature corrections when these are used. The volume per pound of dry air of any mixture of air and water vapor (within the limits usually encountered in drying operations) may be determined directly from charts 3 and 4.

As in the previous charts, horizontal distances indicate dry-bulb temperature or actual temperature of the air. Vertical distances indicate volumes per pound of dry air, one inch representing a volume difference of one cubic foot. Each of the diagonal lines represents a specific mixture of one pound of air with the quantity of moisture, in pounds, indicated by the figure on the line.

For a given set of air conditions, the amount of moisture per pound of dry air is determined by use of sheets

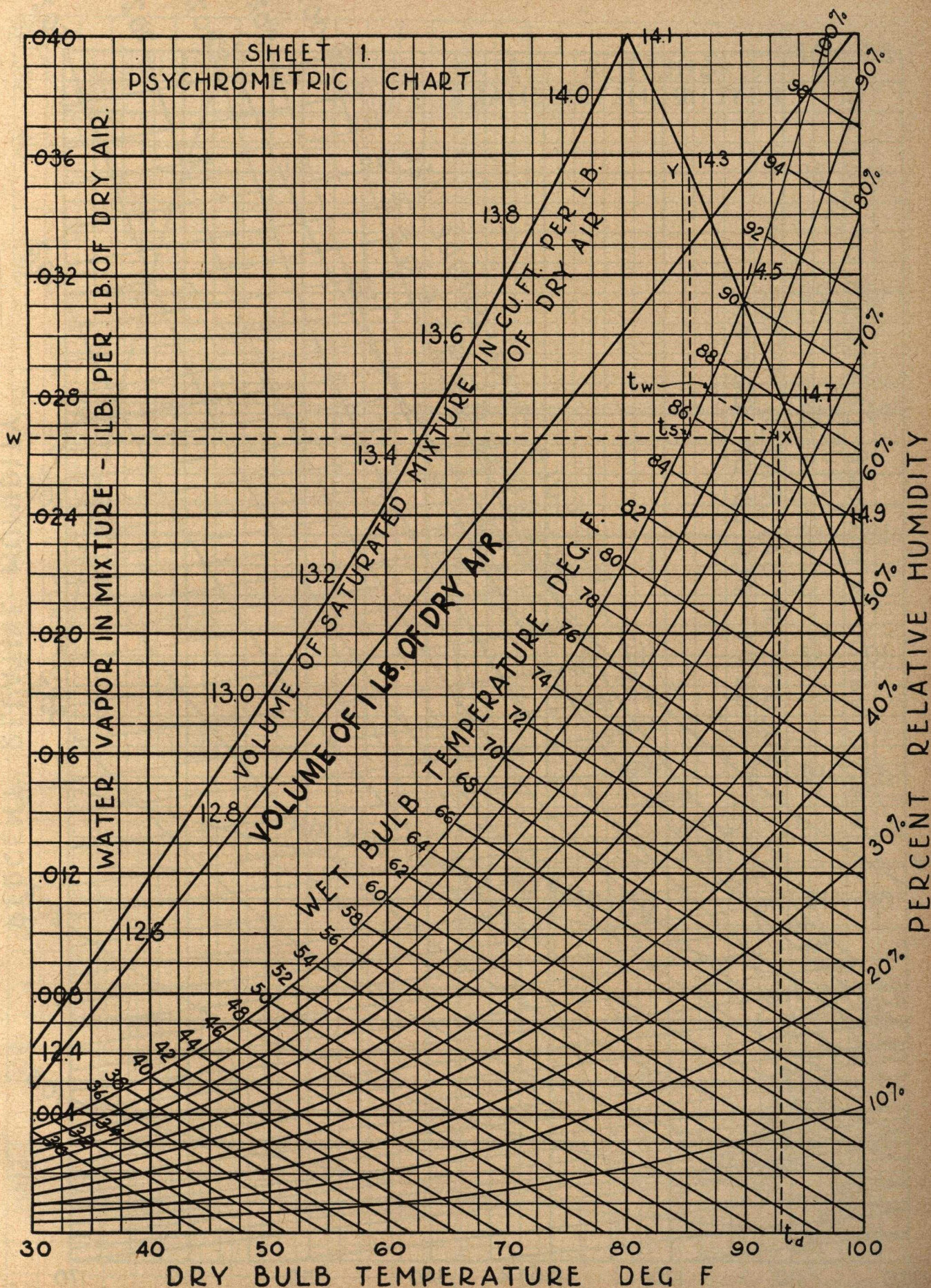
1 or 2. Locate on sheet 3 or 4, the dry bulb temperature on the base line; follow vertically to the diagonal line representing the value, pounds moisture per pound of dry air, then horizontally to the left margin and read the volume of the mixture containing 1 pound of dry air and indicated amount of moisture.

Example: What is the volume per pound of dry air of an air-vapor mixture at a dry bulb temperature of 131° F. and a wet bulb temperature of 115° F.?

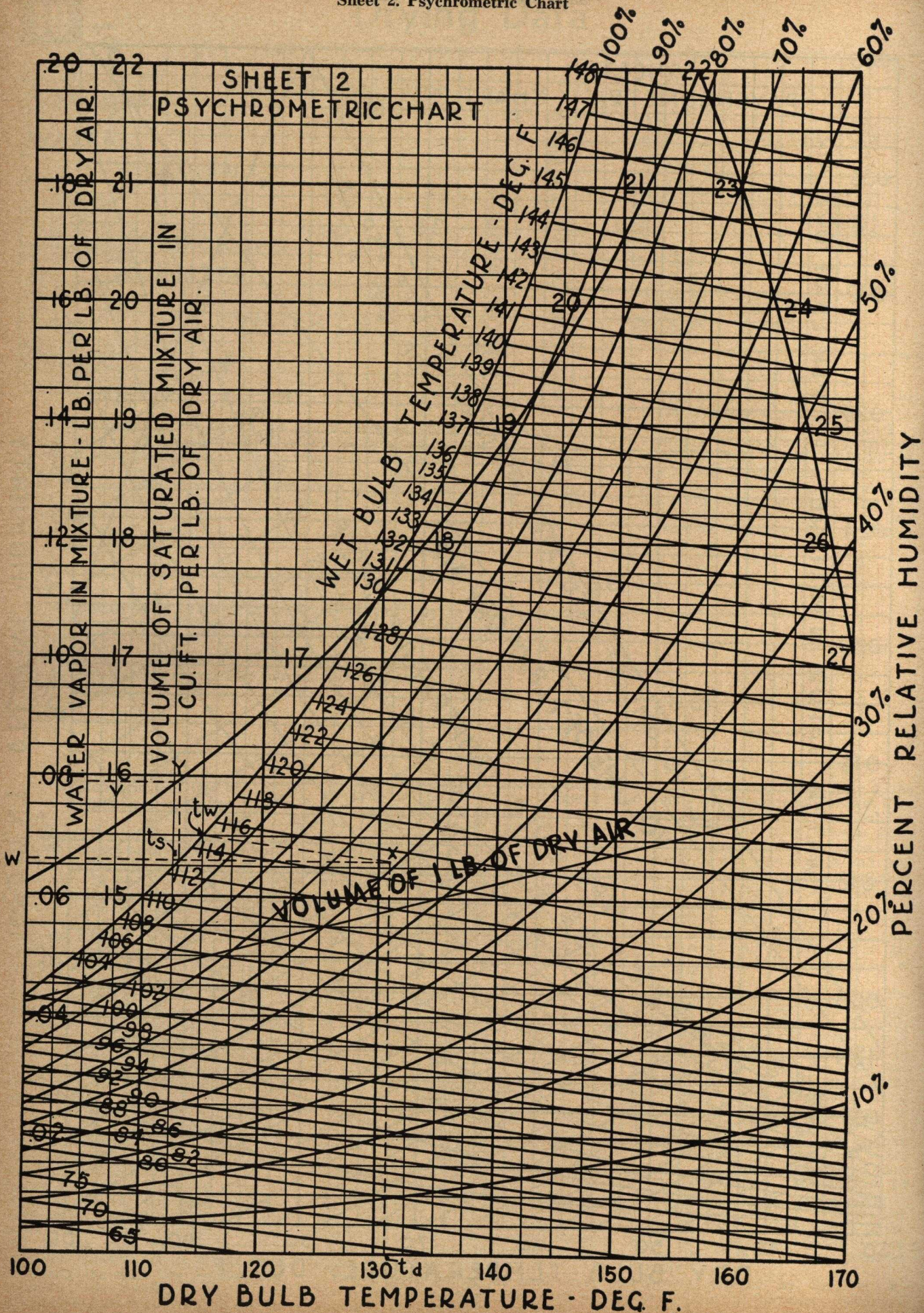
On sheet 2 the dry bulb temperature is located at t_a and the wet bulb temperature at t_w . Following vertically from t_a and diagonally from t_w to X the relative humidity is found to be about 61. Following the dash line horizontally to the left margin, the mixture is found to contain about 0.065 lbs. of moisture per pound of dry air. On sheet 3 the dry bulb temperature is again located along the base line at t_a . The point w lies on the 131° F. line and equidistant from the moisture lines marked .06 and .07 respectively, corresponding to the value .065 lbs. of moisture per pound of dry air. Horizontally to the left from w the volume of the mixture is read as 16.45 cu. ft. per pound of dry air.

Charts checked by Prof. R. K. Hursh, Dept of Ceramics, University of Illinois.

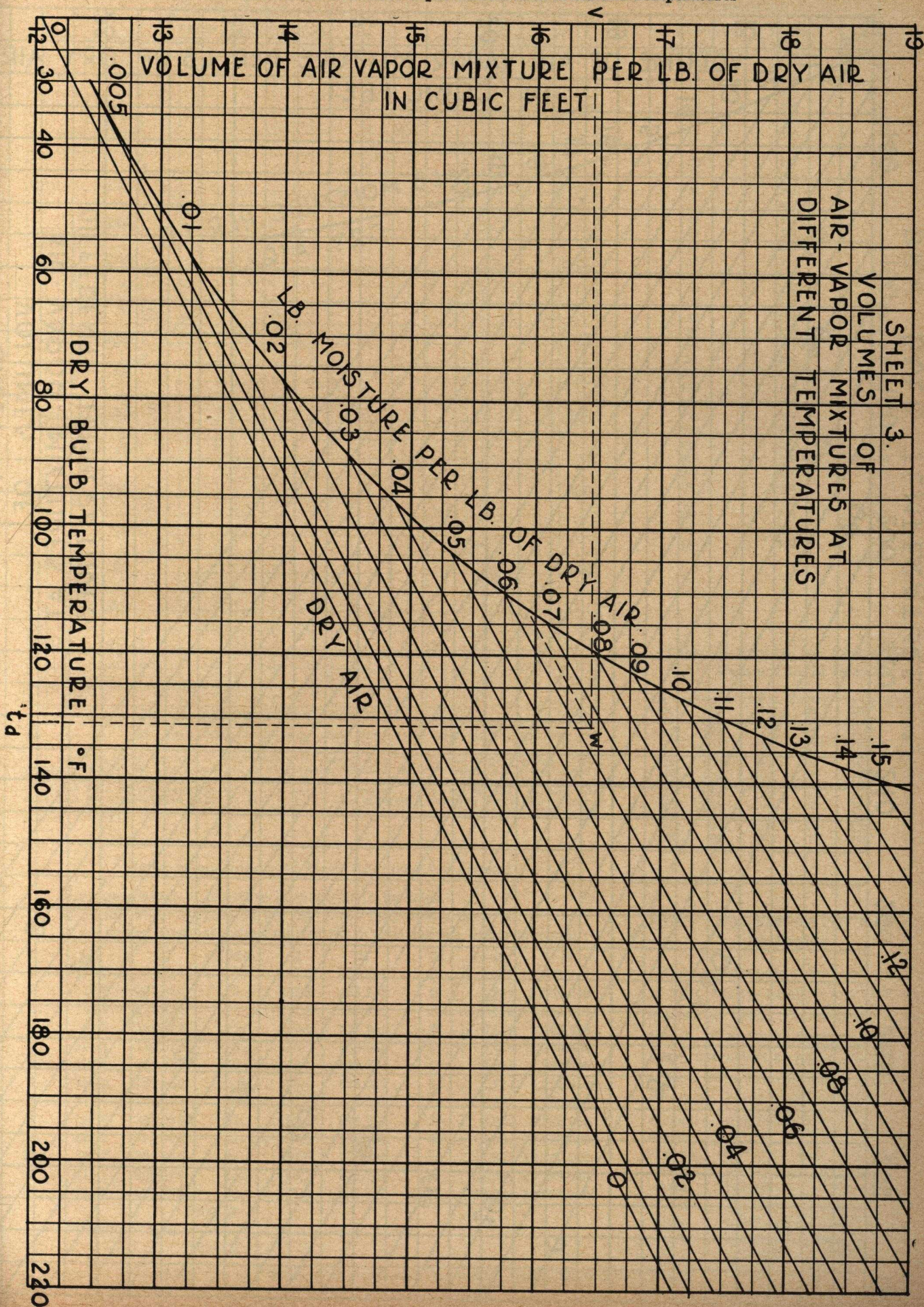
Sheet 1. Psychrometric Chart



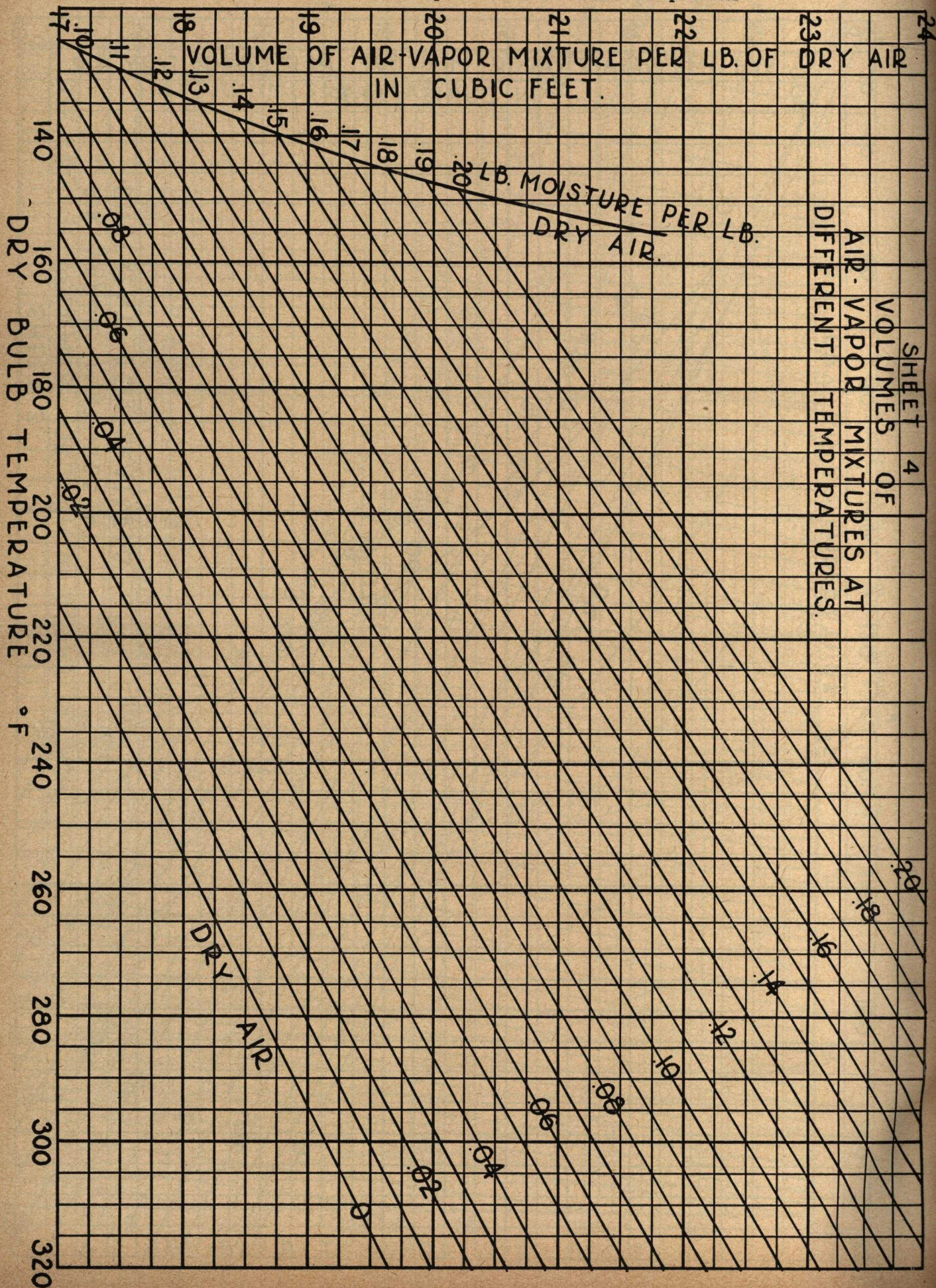
Sheet 2. Psychrometric Chart



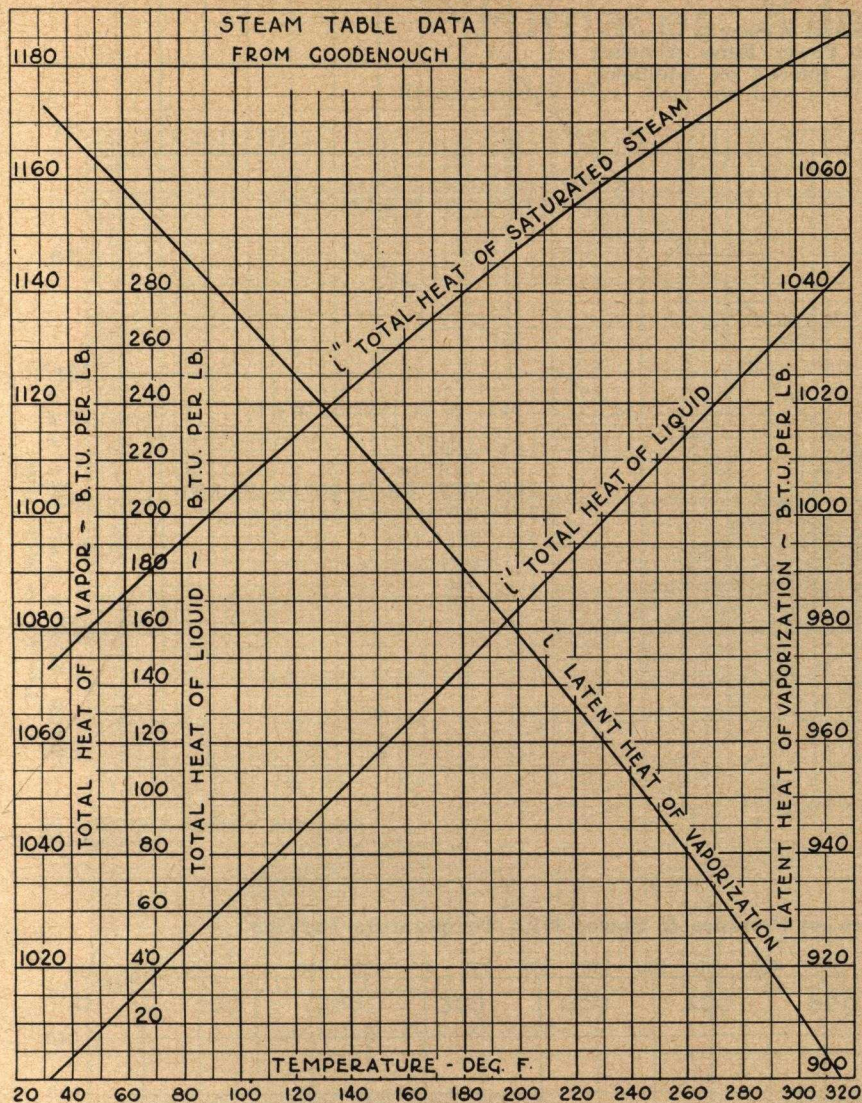
Sheet 3. Volumes of Air-Vapor Mixtures at Different Temperatures



Sheet 4. Volumes of Air-Vapor Mixtures at Different Temperatures



Steam Table Data



To find the heat required to evaporate 1 lb. water from 70° F., the vapor having a temperature of 110° F., the procedure is as follows: Follow the 70° temperature line until it intersects the total heat of liquid curve. Follow horizontally to the left from this point and the total heat of the liquid is 38 b. t. u. per lb. of water. Likewise, at 110° F., the total heat of 1 lb. of saturated vapor is 1109 b. t. u. The difference between these two values is the heat required to evaporate 1 lb. of water under the stated conditions, 1109 — 38 = 1071 b. t. u.

Water Evaporated and Heat Required for Drying

M = percentage of moisture in material to be dried.

Q = lbs. water evaporated per ton (2000 lbs.) of dry material.

H = British thermal units required for drying, per ton of dry material.

M	Q	H	M	Q	H	M	Q	H
1....	20.2	85,624	14....	325.6	424,884	35....	1,077	1,269,240
2....	40.8	108,696	15....	352.9	458,248	40....	1,333	1,555,960
3....	61.9	130,424	16....	381.0	489,720	45....	1,636	1,895,320
4....	83.3	156,296	17....	409.6	521,752	50....	2,000	2,303,000
5....	105.3	180,936	18....	439.0	554,680	55....	2,444	2,800,280
6....	127.7	206,024	19....	469.1	588,392	60....	3,000	3,423,000
7....	150.5	231,560	20....	500.0	623,000	65....	3,714	4,222,680
8....	173.9	257,768	21....	531.6	658,392	70....	4,667	5,290,040
9....	197.8	284,536	22....	564.1	694,792	75....	6,000	6,783,000
10....	222.2	311,864	23....	597.4	732,088	80....	8,000	9,023,000
11....	247.2	339,864	24....	631.6	770,392	85....	11,333	12,755,960
12....	272.7	368,424	25....	666.7	809,704	90....	18,000	20,223,000
13....	298.9	397,768	30....	857.0	1,022,840	95....	38,000	42,623,000

2000 M

Formulae: $Q = \frac{2000 M}{100 - M}$; $H = 1120 Q + 63,000$.

100 — M

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Table of Steam Pressures and Corresponding Temperatures

Approximate Gage Pressure (Lbs. Sq. In.)	Steam Temperatures (°F)	Latent Heat (B.T.U. per Lb.)
0	212	970
2	219	966
5	227	961
10	239	953
15	250	945
20	259	939
25	267	934
30	274	929
35	281	924
40	287	919
45	292	915
50	298	911
55	303	908
60	307	904
65	312	901
70	316	897
75	320	894
80	324	891
85	328	888
90	331	886
95	335	883
100	338	880
125	353	868
150	366	857
175	377	846
200	388	837
225	397	828
250	406	820
275	414	812
300	422	804
325	429	797
350	436	790
375	442	783
400	448	776

Checked 1956

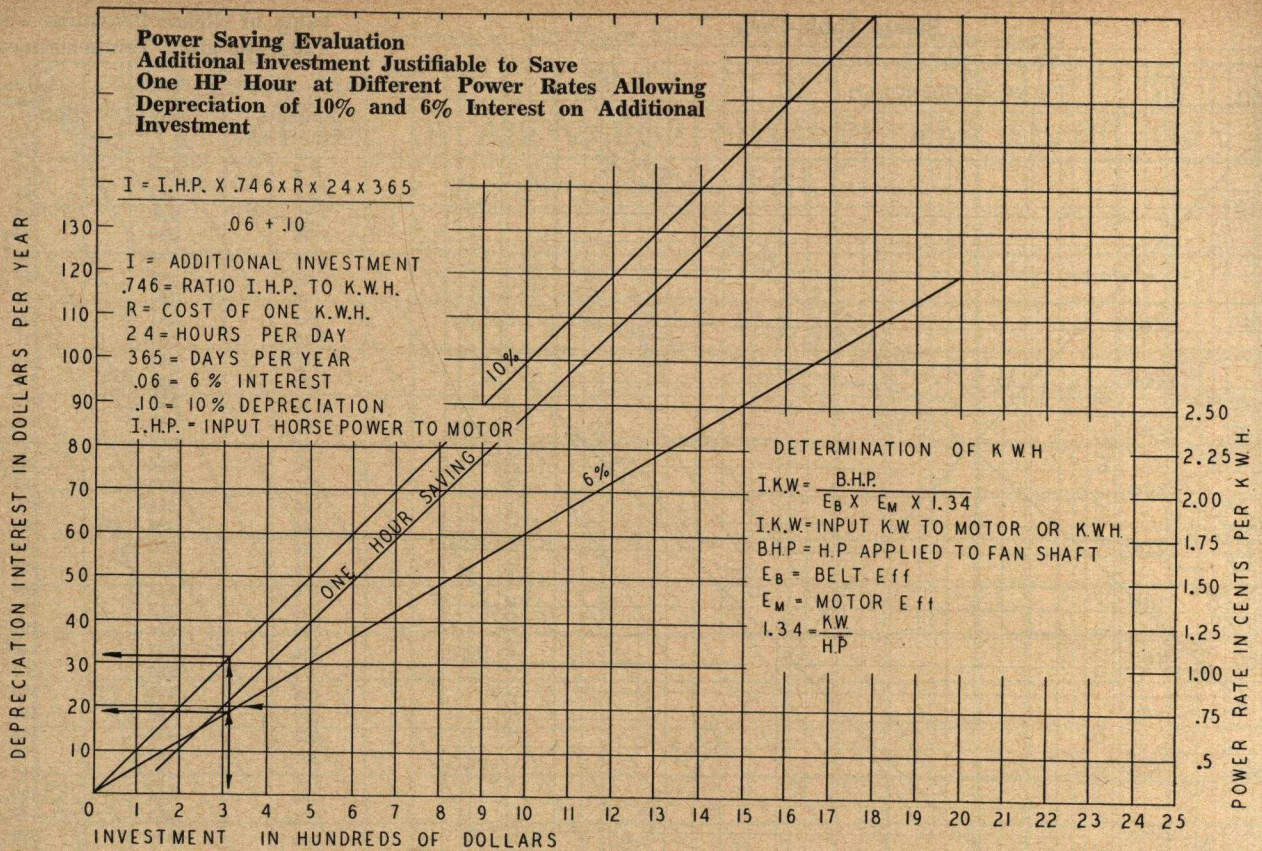
Table of Factors for Correcting Air Volumes to 70 Degrees

Temp. Factor	Temp. Factor	Temp. Factor
30° 1.23	100° .95	230° .77
20° 1.21	110° .93	240° .76
10° 1.18	120° .91	250° .75
0° 1.15	130° .90	260° .74
10° 1.13	140° .88	270° .73
20° 1.10	150° .87	280° .72
30° 1.08	160° .86	290° .71
40° 1.06	170° .84	300° .70
50° 1.04	180° .83	310° .69
60° 1.02	190° .82	320° .68
70° 1.00	200° .80	330° .67
80° .98	210° .79	340° .66
90° .96	220° .78	350° .65

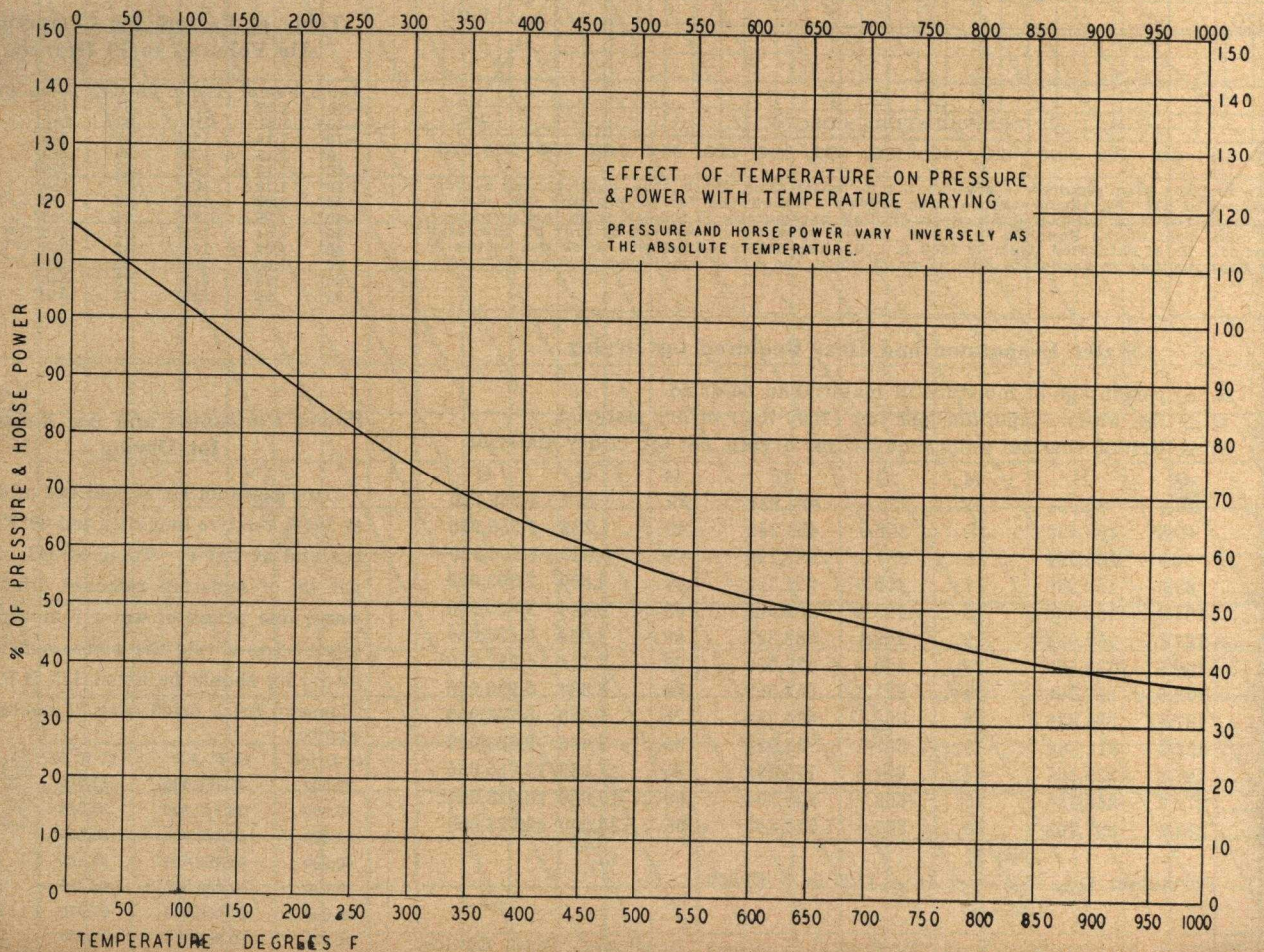
Power Consumed and Air Required for Drying

Data based on air at cool end of dryer at 100% relative humidity and 70°F. and hot end at 200°F. Total of 843 cu. ft. per lb. of moisture removed from the ware; one pound of water removed, per brick. (As a rule the power consumed in drying should be about 1/3 H.P. per thousand brick dried each 24 hours.)

Number of Brick	C. F. Air	C. F. M.	B. H. P.
30,000	25,450,000	17,600	5
40,000	33,900,000	23,500	7.5
50,000	42,100,000	30,000	9
60,000	50,900,000	35,100	10.1
70,000	59,000,000	42,000	13.8
80,000	67,900,000	47,000	15
90,000	76,000,000	52,700	25
100,000	84,300,000	58,000	30



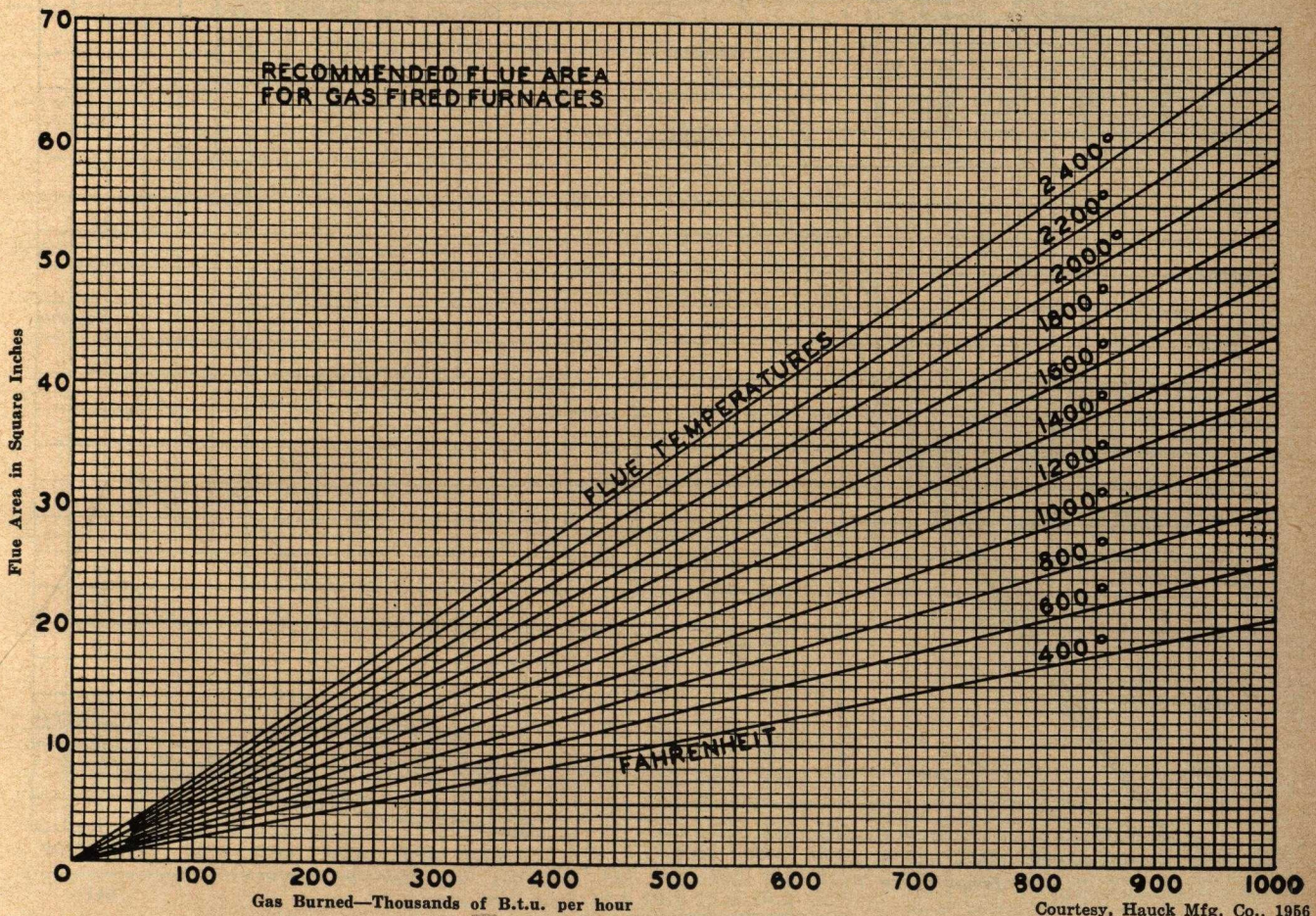
Effect of Temperature on Pressure & Power With Temperature Varying



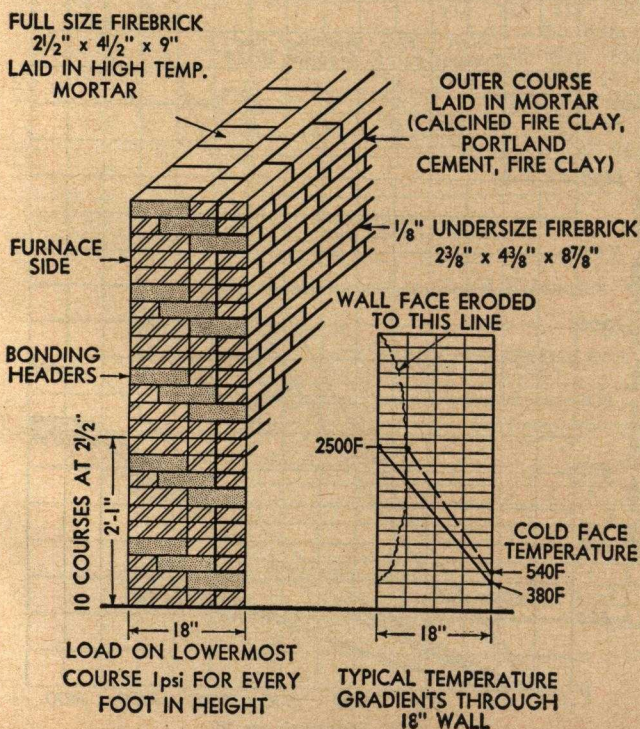
Furnaces, Kilns

11

Recommended Flue Area for Gas Fired Furnaces

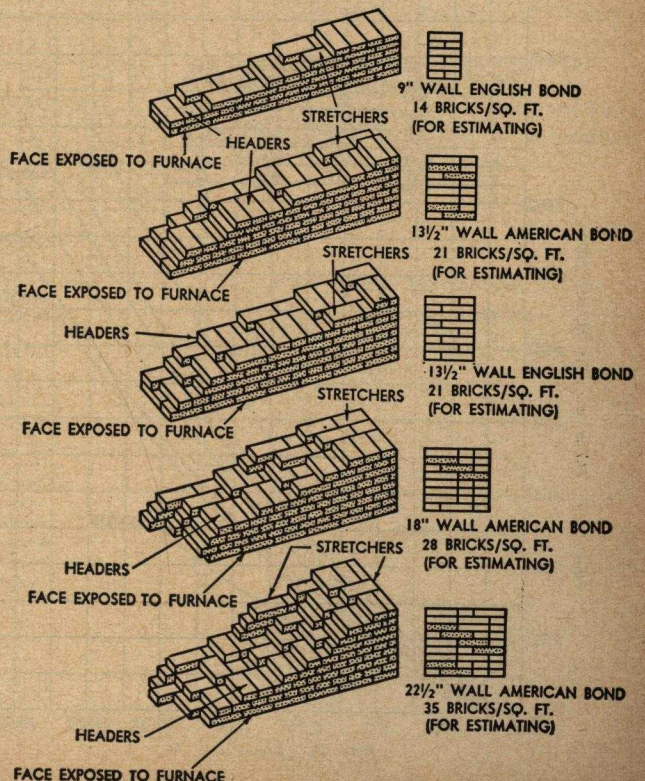


Structure, Loading and Temperature Gradients for 18-inch Firebrick Furnace Wall



Courtesy, Babcock & Wilcox Co., 1956

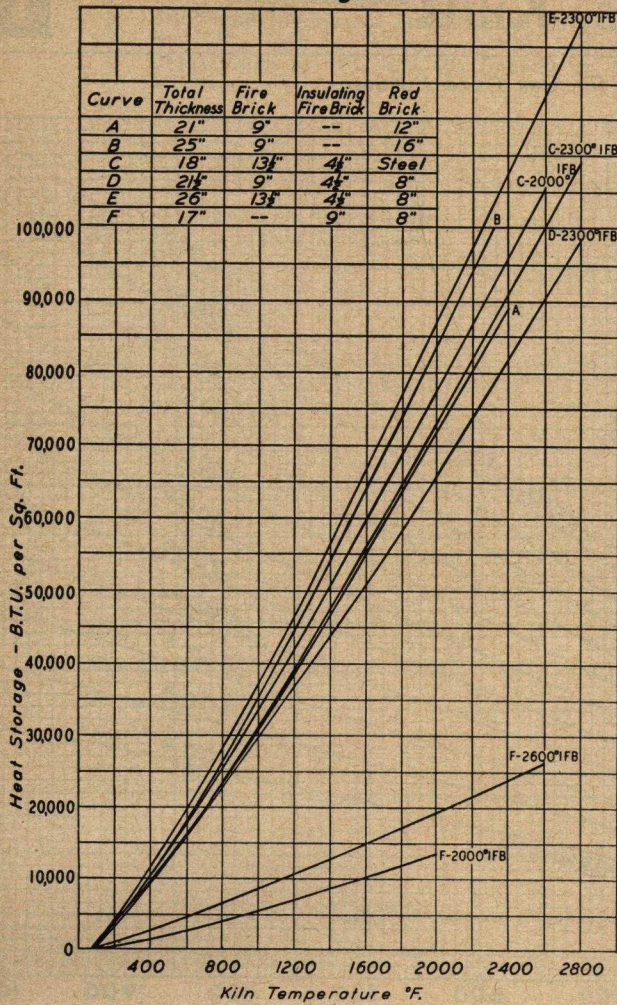
Firebrick Walls—English and American Bond



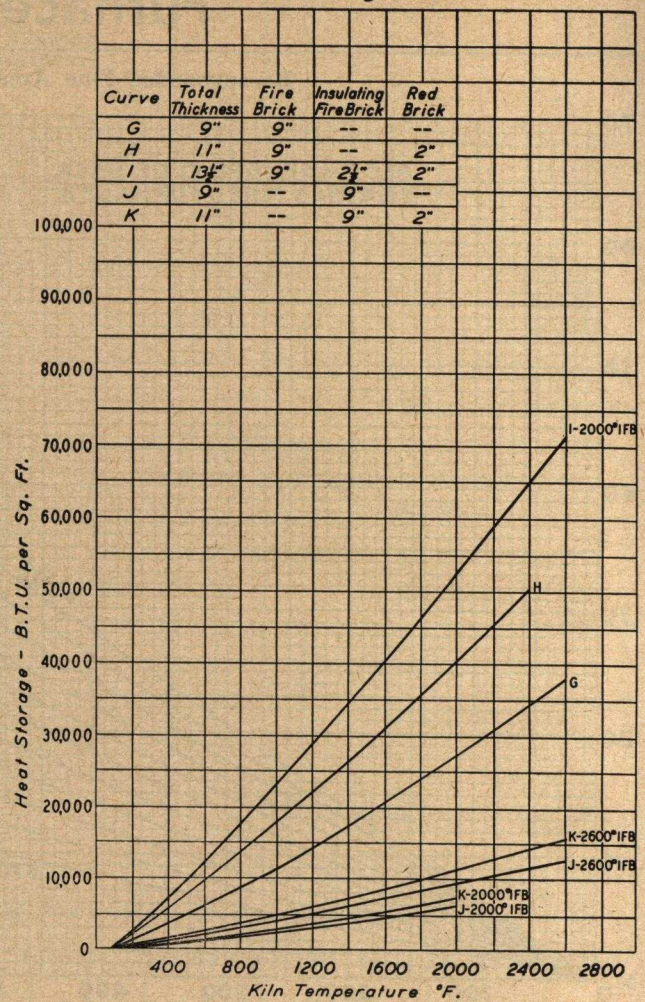
Courtesy, Babcock & Wilcox Co., 1956

Heat Losses Through Kiln Walls and Crown

Heat Storage - Walls

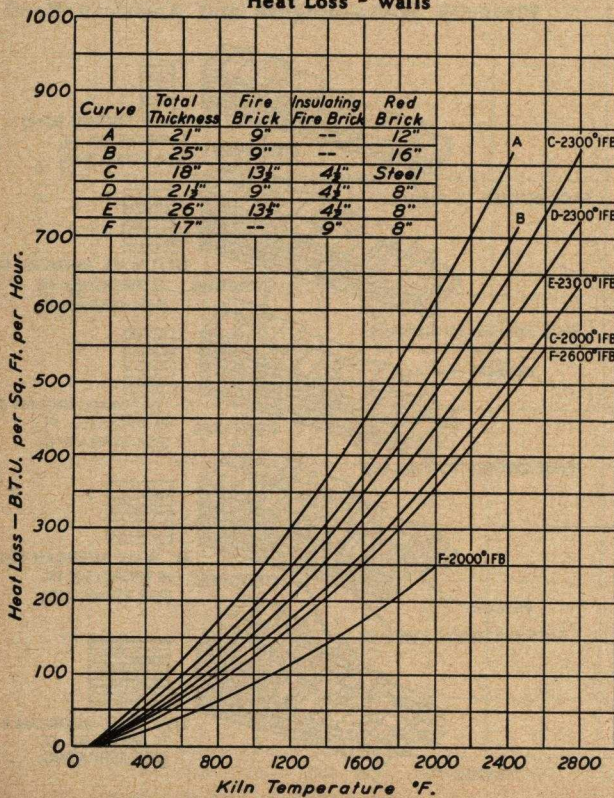


Heat Storage - Crown



Heat Storage in Kiln Walls and Crown

Heat Loss - Walls



Heat Loss - Crown

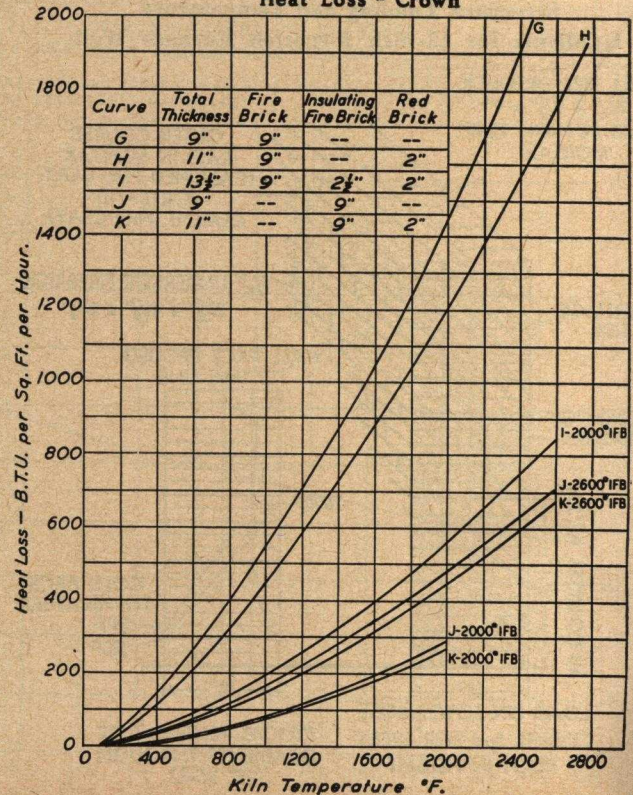
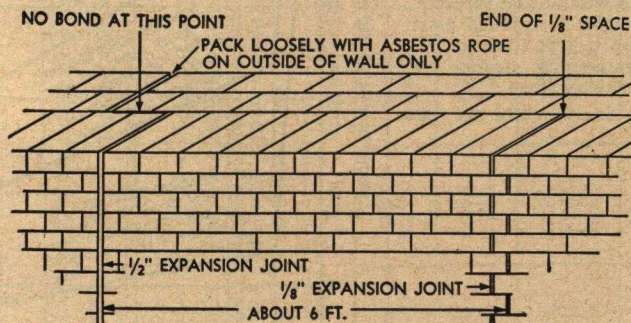


Table of Sizes for Natural-draft Chimneys

Amount of gases flowing, lb. per sec.	Required draft at breeching entrance, in. water—													
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	
	Economical size of chimney height and diameter, ft.													
5	75	95	115	135	150									
	3.5	3.5	3.5	3.5										
10	75	95	115	135	150									
	4.0	4.0	4.0	4.0	4.0									
15	75	95	115	135	150	170	190							
	4.5	4.5	4.5	4.5	4.5	4.5	4.5							
20	75	95	115	135	150	170	190							
	5.0	5.0	5.0	5.0	5.0	5.0	5.0							
25	75	95	115	135	150	170	190							
	5.5	5.5	5.5	5.5	5.5	5.5	5.5							
30		95	115	135	150	170	190							
		5.5	5.5	5.5	5.5	5.5	5.5							
35		95	115	135	150	170	190	210						
		6.0	6.0	6.0	6.0	6.0	6.0	6.0						
40		95	115	135	150	170	190	210						
		6.5	6.5	6.5	6.5	6.5	6.5	6.5						
45		95	115	135	150	170	190	210						
		6.5	6.5	6.5	6.5	6.5	6.5	6.5						
50			115	135	150	170	190	210	230					
			7.0	7.0	7.0	7.0	7.0	7.0	7.0					
60				115	135	150	170	190	210	230				
				7.5	7.5	7.5	7.5	7.5	7.5					
70					150	170	190	210	230	250	270	290	310	
					8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
80						150	170	190	210	230	250	270	290	310
						8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
90							170	190	210	230	250	270	290	310
							9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
100								170	190	210	230	250	270	290
								9.5	9.5	9.5	9.5	9.5	9.5	9.5
110									170	190	210	230	250	270
									9.5	9.5	9.5	9.5	9.5	9.5
120										170	190	210	230	250
										10.0	10.0	10.0	10.0	10.0
130											170	190	210	230
											10.5	10.5	10.5	10.5
140												170	190	210
												10.5	10.5	10.5
150													170	190
													11.0	11.0
160														170
														11.0
170														
														11.5
180														
														12.0
190														
														12.0
200														
														12.5

Based on: 62° F. atmospheric temperature, 500° F. chimney gas temperature, 0.09 chimney gas density, 0.016 coefficient of friction, sea level elevation.

Expansion Joints in Solid Firebrick Walls



Courtesy, The Babcock & Wilcox Co., 1956

How to Mix Refractory Concrete

LOW TEMPERATURE SERVICE 2000° AND UNDER

PROPORTIONS

1 bag LUMNITE to 4 cu. ft. of aggregate
Note—1 bag LUMNITE = 1 cu. ft. = 94 lbs. A one bag batch of 1:4 mix will yield approximately four cubic feet of Refractory Concrete.
The load-bearing capacity of Refractory Concrete in service at 2000° F. and under will be increased with a somewhat richer mix. A 1:3 mix should be used where heavy loads will be imposed directly on the Refractory Concrete. This condition holds for some ceramic-kiln car tops and annealing-furnace car tops where heavy ware and castings are fired.

AGGREGATE

Fire Clay Grog
Refractory Insulating Firebrick Grog*
Crushed Fire Brick
Crushed Insulating Brick*
Crushed Pottery Saggers

AGGREGATE

Diatomaceous Earth* (service maximum 1800° F.)
Haydite*
Olivine
Trap Rock service maximum 1800° F.)
When both insulating and refractory properties are desired, vermiculite may be used in combination with fire clay aggregate or Haydite. The addition of vermiculite increases the insulating value but decreases the strength and resistance to abrasion.
*For Refractory Insulating Concrete.

MEDIUM TEMPERATURE SERVICE 2000° F. TO 2600° F.

PROPORTIONS

LUMNITE: Aggregate
Service Temperature Bags Cu. Ft.
2000° F.-2300° F. 1 : 5
2300° F.-2600° F. 1 : 6
Certain installations may require the aggregates suggested for high temperature furnaces.
When aggregates recommended for high temperature furnaces are used for medium temperature furnaces a 1:6 mix should be used.

AGGREGATE

Fire Clay Grog
Refractory Insulating Firebrick Grog
(Maximum service temperature should be obtained from the manufacturer)
Crushed Firebrick
Crushed Pottery Saggers
For service above 2600° F. aggregate should have a softening point of Cone 30 or higher. When heated on all sides at temperatures above 2000° F. Refractory Concrete has little or no load-bearing capacity.

HIGH TEMPERATURES SERVICE 2600° F. AND OVER

PROPORTIONS

1 bag LUMNITE to 6 or 7 cu. ft. of aggregate.

AGGREGATE

Bauxite (calcined) Magnesite (dead-burned)
Chromite
Diaspore (calcined) Mullite
Fused Alumina Sillimanite (calcined)
Kyanite (calcined)
Checked by Universal Atlas Cement Co., 1956

Fire Brick Estimating Table

For estimating on brickwork, use the following figures: 200 to 450 lbs. of high temperature mortar or fire clay to lay one thousand CLAY 9-in. straight brick, and 300 to 600 lbs. of mortar to lay 1,000 BASIC 9-in. straight brick.

1 sq. ft. of wall 4½ in. thick requires seven 9-in. straight brick in 2½-in. series, and 6 in 3-in. series.

1 sq. ft. of wall 9 in. thick requires thirteen 9-in. straight brick 2½-in. series and 11 in 3-in. series.

1 sq. ft. of wall 13½ in. thick requires twenty 9-in. straight brick in 2½-in. series, and 16 in 3-in. series.

1 cu. ft. of brickwork requires seventeen (17.07) 9-in. straight brick in 2½-in. series, and fourteen (14.2) in 3-in. series.

1 cu. ft. of fireclay brick weighs 125 to 140 lbs.

1 cu. ft. of silica brick weighs 105 to 120 lbs.

1,000 straight 9-in. brick (very closely stacked) in 2½-in. series occupy 58.6 cu. ft., in 3-in. series occupy 70.3 cu. ft.

Standard Sizes of Graphite Crucibles^a

Number	Height outside in inches	Diam top outside in inches	Approx working capacity in lb red brass	Approx working capacity in lb aluminum	Approx working capacity in lb magnesium
1	3 $\frac{3}{8}$	3 $\frac{3}{4}$	3.0	0.93	0.60
1 $\frac{1}{2}$	4 $\frac{1}{16}$	3 $\frac{3}{16}$	4.3	1.3	0.83
2	4 $\frac{1}{2}$	3 $\frac{3}{4}$	4.7	1.4	0.90
3	5 $\frac{3}{8}$	4 $\frac{1}{4}$	7.7	2.3	1.5
4	5 $\frac{3}{4}$	4 $\frac{3}{8}$	10	3.1	2.0
5	6 $\frac{3}{8}$	4 $\frac{7}{8}$	14	4.3	2.8
6	6 $\frac{1}{2}$	5 $\frac{1}{4}$	15	4.6	3.0
7	6 $\frac{3}{4}$	5 $\frac{1}{2}$	21	6.5	4.2
8	7 $\frac{3}{8}$	5 $\frac{7}{8}$	24	7.4	4.8
9	7 $\frac{3}{4}$	5 $\frac{3}{4}$	26	8.0	5.1
10	8 $\frac{1}{16}$	6 $\frac{1}{16}$	36	11	7.1
12	8 $\frac{1}{2}$	6 $\frac{3}{8}$	42	12	7.7
14	8 $\frac{7}{8}$	6 $\frac{11}{16}$	47	14	9.0
16	9 $\frac{1}{4}$	6 $\frac{15}{16}$	53	16	10
18	9 $\frac{13}{16}$	7 $\frac{5}{16}$	64	18	12
20	10 $\frac{5}{16}$	7 $\frac{11}{16}$	74	20	13
25	10 $\frac{15}{16}$	8 $\frac{3}{8}$	89	25	16
30	11 $\frac{1}{2}$	8 $\frac{3}{4}$	100	30	19
35	12	9	120	35	23
40	12 $\frac{1}{2}$	9 $\frac{3}{8}$	130	40	26
45	13 $\frac{3}{16}$	9 $\frac{7}{8}$	160	45	29
50	13 $\frac{3}{4}$	10 $\frac{1}{4}$	180	50	32
60	14 $\frac{7}{16}$	10 $\frac{13}{16}$	210	60	39
70	15 $\frac{1}{16}$	11 $\frac{1}{4}$	240	70	45
80	15 $\frac{3}{8}$	11 $\frac{11}{16}$	270	80	51
90	16 $\frac{3}{16}$	12 $\frac{3}{8}$	300	90	58
100	16 $\frac{11}{16}$	12 $\frac{1}{2}$	330	100	64
125	17 $\frac{3}{8}$	13	370	125	80
150	18 $\frac{3}{8}$	13 $\frac{3}{4}$	470	150	96
175	19 $\frac{1}{4}$	14 $\frac{3}{8}$	520	175	110
200	20	15	600	200	130
225	20 $\frac{3}{4}$	15 $\frac{1}{2}$	670	225	140
250	21 $\frac{3}{8}$	16	750	250	160
275	22	16 $\frac{7}{16}$	820	275	180
300	22 $\frac{1}{2}$	16 $\frac{3}{8}$	900	300	190
400	24 $\frac{5}{16}$	18 $\frac{3}{16}$	1200	400	260

^a Within the range of this table, crucibles are standardized as to volume and capacity. Crucibles above size 400 are rarely used for brass, since the weight of so much brass leads to structural difficulties in the crucible. Large crucibles up to size 1000 are frequently used for light metals such as aluminum, but these large sizes are not yet standardized, and their capacities depend upon the company making them.

Courtesy, North American Mfg. Co., 1956

Calculating Draft for Chimneys

The intensity of draft or the difference in pressure is measured in inches of water and may vary from 0" to 2" or more. Intensity of draft is given by the following formula:

$$f = 0.518 H \times P \times \left\{ \frac{1}{T_o} - \frac{1}{T_c} \right\}$$

f = Draft in inches of water.

H = Height of chimney in feet.

P = Atmospheric pressure in pounds per square inch.

T_o = Absolute temperature of outside air.

T_c = Absolute temperature of gases inside the chimney.

To facilitate the use of this formula it is assumed that:

P = Atmospheric pressure at sea level or 14.7 pressure per square inch. The absolute temperature of the outside air 520° Fahr.

This formula then reduces to

$$f = H \times 0.518 \times 14.7 \times \left\{ \frac{520}{1} - \frac{T_c}{1} \right\}$$

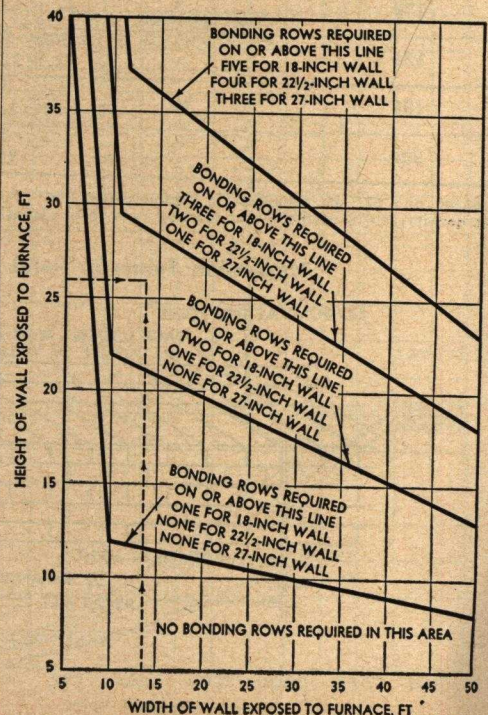
$$\text{Or } f = C \times H$$

$$\text{Where } C = 0.518 \times 14.7 \times \left\{ \frac{1}{520} - \frac{1}{T_c} \right\}$$

The following table gives values for C for different chimney temperatures:

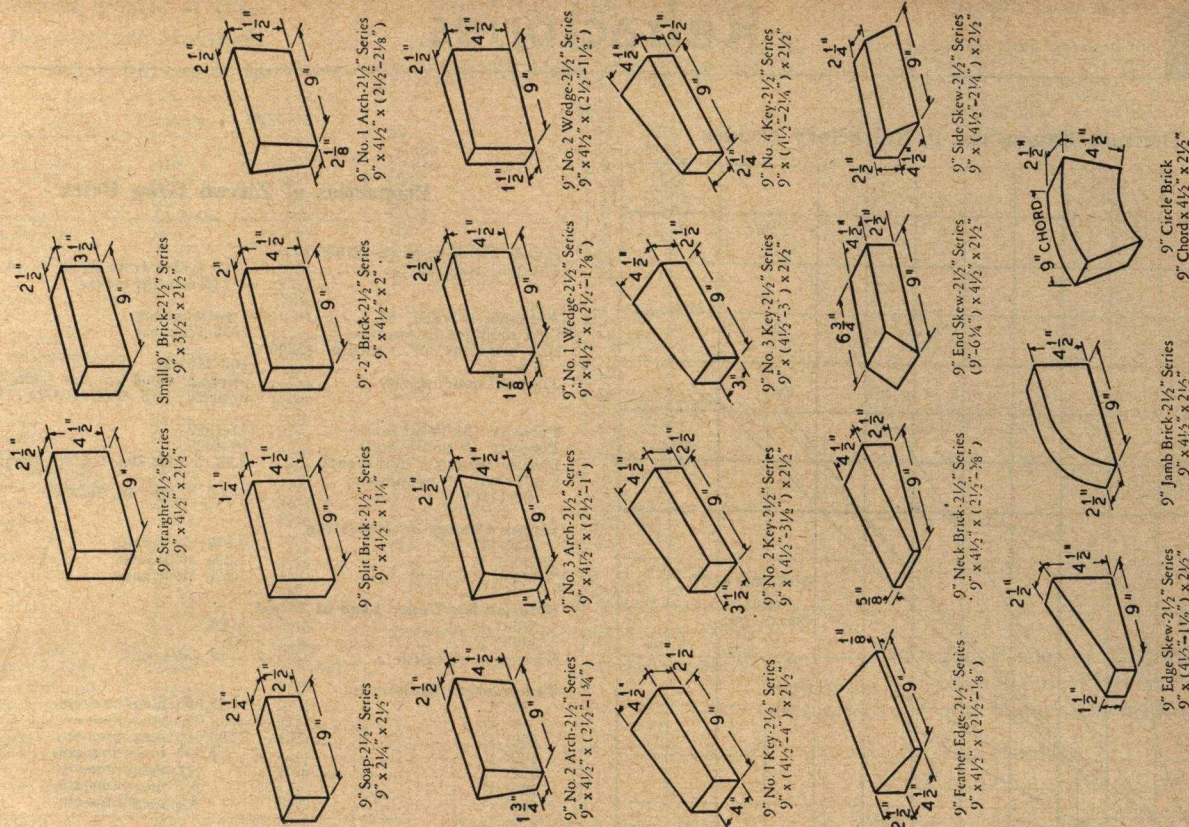
Temperature Gases Inside Chimney	Constant
350	.0053
400	.0058
450	.0063
500	.0067
550	.0071
600	.0075
650	.0078
700	.0081
750	.0084
800	.0086
850	.0088
900	.0091
950	.0093
1000	.0094

Number of Bonding Rows Required For Varying Thickness, Height, And Width of Furnace Firebrick Wall



Courtesy, The Babcock & Wilcox Co., 1956

Common Standard Sizes of Refractory Bricks



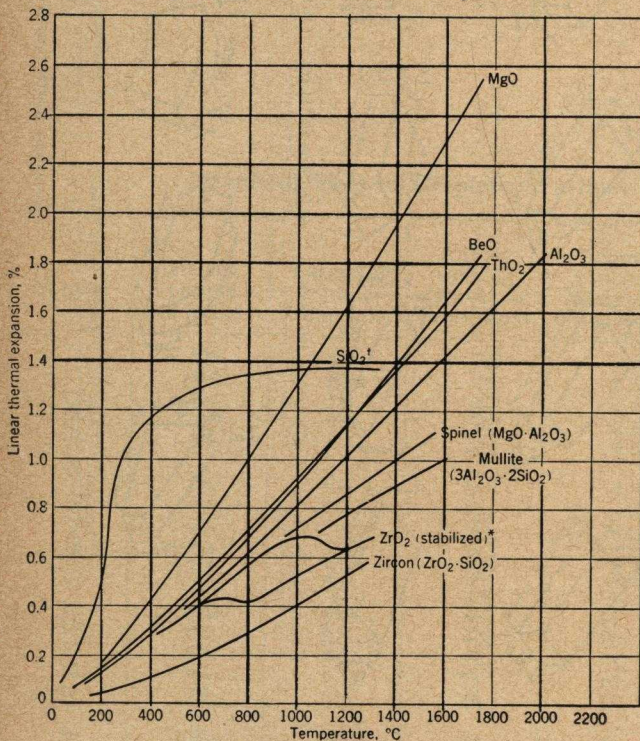
Effect of Regenerator Flue Size and Brick Thickness
(Bricks 4 1/4 in. deep)

Side of the flue, in.	Thickness of brick, in.	Cross-section of cell and per unit cell, sq. ft.	Heating surface per cubic foot of checkerwork, sq. ft.	Weight of face per cubic foot of bricks, lb.	Ratio of free area to total (plan) area
<i>Standard Checkers</i>					
2 1/2	1 1/4	0.0976	7.00	42.0	0.444
	2 1/2	0.173	5.48	62.5	0.250
3 1/2	1 1/4	0.156	8.73	33.1	0.546
	2 1/2	0.250	1.163	52.1	0.340
4 1/2	1 1/4	0.230	1.063	27.4	0.613
	2 1/2	0.342	1.378	44.8	0.412
	4 1/2	0.562	1.870	62.5	0.250
5 1/2	1 1/4	0.315	1.255	23.3	0.664
	2 1/2	0.445	1.593	39.1	0.472
	4 1/2	0.693	2.066	56.3	0.302
6 1/2	1 1/4	0.416	1.445	20.3	0.705
	2 1/2	0.562	1.805	34.7	0.520
	4 1/2	0.840	2.380	51.1	0.349
<i>Solid Chimney Checkers</i>					
4 1/2	1 1/4	0.230	1.500	48.4	0.613
	2 1/2	0.342	1.500	73.4	0.412
5 1/2	1 1/4	0.315	1.833	42.0	0.664
	2 1/2	0.445	1.833	65.8	0.472

Checked by Harbison-Walker Refractories Co., 1952

Refractories

Thermal Expansion of Refractory Oxides



*Depends on degree of stabilization
†Depends on Crystalline forms

CDB, Revised 1956

Properties of Zircon Grog Brick

P.C.E. above cone 42 (3700° F.)

Thermal spalling —13 cycles from 2500° F. in air blast (10-minute cycles)

Abrasion at 1800° F. —satisfactory

Cold modulus of rupture 1650-2700 psi

Hot modulus of rupture (2200° F.) 160-210 psi

Thermal conductivity approx. 0.005 cal./cm.²/cm./°C./sec.approx. 14.5 BTU/ft.²/in./°F./hr.

Porosity (24 hours soak) 11-18%

Porosity (5 hours boil) 16-20%

Specific gravity (apparent) 3.23 or 12.3 lbs. per 9" straight brick

Coefficient of expansion (20-1100° C.) —4.0 X 10⁻⁶ in./in./°C.

Linear Change on Reheating

2800° F. 0.3% shrinkage

2950° F. 1.2% shrinkage

3400° F. 1.2% shrinkage

Deformation Under Load at 25 psi

2750° F. 2-4%

2900° F. 5%

Dielectric strength —40 volts/mill

Temperature Resistivity

20° C. —33,000 megohms-cm.

50° C. —12,000 megohms-cm.

150° C. 500,000 megohms-cm.

300° C. 4,500 megohms-cm.

500° C. 18 megohms-cm.

700° C. 0.7 megohms-cm.

800° C. 0.3 megohms-cm.

Checked 1956 by Titanium Alloy Mfg., Div. National Lead Co.

Properties of Stabilized Zirconia

Slip Cast Ware

Bulk specific gravity 5.16-5.19 grams/cm.³
0.186-0.187 lbs./in.³
323-324 lbs./ft.³

Absorption 0.7-0.9 percent

Modulus of rupture... 9600-10300 lbs./in.²

Thermal shock resistance 16-20 cycles

Air quench from
2800° F.Fusion temperature... 4600-4700° F.
2540-2600° C.

Hot load test No failure at 3600° F.*

*Using load of 50 psi instead of standard 25 psi load no failure occurred at 3600° F. Subsidence of test block under conditions noted as only 4.0 percent.
Courtesy, Titanium Alloy Mfg. Div. National Lead Co. Checked 1956.

Effect of Grain Size on Abrasion Resistance

Wet Quartzite; 600 Ft. per Min. 4000 Ft. Test Distance.

Steel	Rockwell C Hardness	Average Weight Loss (grams x 10)			
		28/35 mesh		65/100 mesh	
		60 psi	180 psi	60 psi	180 psi
SAE 1045	59/61	41.0	241.0	15.2	60.5
SAE 1095	61/62	44.5	178.0	13.7	52.6
12Cr-2.20C	60/61	3.8	55.0	1.1	3.0
Modified high speed	61/64	2.1	18.0	0.3	1.8

Relative Abrasiveness of Refractory Materials

Wet laboratory tests; 28/35 mesh particles; speed 600 ft. per min.
60 Psi load; 4000 ft. test distance

Steel	Rockwell C Hardness	Average Weight Loss (grams x 10)		
		Ganister	Chromite	Magnesite
SAE 1095	65/66	44.5	66.0	6.7
12Cr-2.2C	60/61	3.8	6.8	0.9

Effects of Speed and Pressure on Abrasion Resistance

28/35 Mesh Wet Quartzite; 4000 ft. Test Distance

Steel	Rockwell C Hardness	Average Weight Loss (grams x 10)			
		60 Ft. per Min.		600 Ft. per Min.	
		60 psi	160 psi	60 psi	160 psi
SAE 1045	59 /61	24.5	122.0	41.0	241.0
SAE 1095	61 /62	14.4	97.9	44.5	178.0
12Cr-2.20C	63.5/65	1.2	7.3	3.4	44.0
Modified high speed	61 /63	1.5	12.4	2.1	18.0
Ni-Cr Iron	56 /58	4.3	22.2	3.3	23.0
High-Cr Iron	62 /63	1.6	15.2	9.4	64.0

Courtesy, Chisholm, Boyd & White Co.
Checked 1956

Crushing Strength of Refractories

Material	Crushing strength lb. per square inch
Fireclay brick	2,000 to 12,000
Bauxite brick	6,000
Silica brick	3,000 to 5,000
Zirconia	7,000
Magnesite	5,000 to 8,000
Chrome	6,000
Insulating brick	50 to 500

Reprinted from "Refractories," by Norton, published by McGraw-Hill Book Co., Inc.

Melting Points of High Temperature Materials

Melting Pts. greater than 1800°C

Name	Formula	M.P. (°C)
Aluminum nitride	AlN	2200
Aluminum oxide	Al ₂ O ₃	2050
Barium oxide	BaO	1923
Barium zirconate	BaZrO ₃	2700
Beryllium carbide	Be ₂ C	>2100
Beryllium nitride	Be ₃ N ₂	2200
Beryllium oxide	BeO	2570
Boron	B	2600
Boron carbide	B ₄ C	2350
Boron nitride	BN	2730 ca
Calcium carbide	CaC ₂	2297
Calcium metazirconate	CaZrO ₃	2550
Calcium oxide	CaO	2572
Calcium silicate	a-Ca ₂ SiO ₄	2130
Carbon	C	3500
Cerium oxide	Ce ₂ O ₃	1950
Cerium sulfide	CeS	2450
Chromium carbide	CrC	1890
Chromium dicarbide	Cr ₃ C ₂	1890
Chromium sesquioxide	Cr ₂ O ₃	1990
Cobalt oxide	CoO	1805
Gallium oxide	Ga ₂ O ₃	1740
Hafnium	Hf	2207
Hafnium boride	HfB	3062
Hafnium carbide	HfC	4160
Hafnium nitride	HfN	3307
Hafnium oxide	HfO ₂	2812
Iridium	Ir	2350
Lanthanum oxide	La ₂ O ₃	2316
Lanthanum sulphide	La ₂ S ₃	2100 vac
Magnesium aluminate	MgAl ₂ O ₄	2135
Magnesium oxide	MgO	2500
Manganese oxide	MnO	1780
Molybdenum	Mo	2620
Molybdenum carbide (mono)	MoC	2570
Molybdenum carbide (di)	Mo ₂ C	2380
Nickel oxide	NiO	2090
Niobium	Nb	1950
Niobium carbide	NbC	3500
Niobium nitride	NbN	2050 d
Niobium oxide	Nb ₂ O ₅	1772
Osmium	Os	2700
Rhenium	Rh	3000
Rhodium	Rd	1996
Ruthenium	Ru	2450
Samarium sulfide	Sm ₂ S ₃	1900
Scandium nitride	ScN	2650
Silicon carbide	SiC	2537
Silicon nitride	SiN	1900
Silicon oxide	SiO ₂	1728
Strontium oxide	SrO	2415
Strontium zirconate	SrZrO ₃	2700
Tantalum	Ta	2850
Tantalum carbide	TaC	4150
Tantalum nitride	TaN	3360
Tantalum oxide	Ta ₂ O ₅	1890
Thorium	Th	1845
Thorium carbide	ThC ₂	2773
Thorium oxide	ThO ₂	>2800
Thorium zirconate	ThZrO ₃	2800
Tin oxide	SnO ₂	1900
Titanium	Ti	1800
Titanium carbide	TiC	3140
Titanium nitride	TiN	3220
Titanium oxide	TiO ₂	1840
Titanium sesquioxide	Ti ₂ O ₃	2130 d
Tungsten	W	3340
Tungsten boride	WB	2922
Tungsten carbide	WC	2777
Tungsten carbide	W ₂ C	2857
Uranium	U	1850
Uranium oxide	UO ₂	2176
Uranium carbide	UC ₂	2260
Uranium carbide	U ₃ C ₃	2400
Vanadium carbide	VC	2827
Vanadium nitride	VN	2320 ca
Vanadium sesquioxide	V ₂ O ₃	1970
Vanadium tetraoxide	V ₂ O ₄	1967
Ytterbium	Yb	1800
Yttrium oxide	Y ₂ O ₃	2410
Zinc oxide	ZnO	1975
Zirconium	Zr	1900
Zirconium boride	ZrB	2922
Zirconium carbide	ZrC	3532
Zirconium nitride	ZrN	2982
Zirconium oxide (baddeleyite)	ZrO ₂	2700
Zirconium oxide (zirconia)	ZrO ₂	2950
Zirconium orthosilicate (zircon)	ZrSiO ₄	1775
4TaC + 1 ZrC		3932
4TaC + 1 HfC		3942

ca = approximately.

d = decomposed.

vac = in vacuum.

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Super Duty Clay Flux Block

The term "super duty clay" flux block refers to two grades within the following range of composition and physical properties.

SD-1	
SiO ₂	54 - 56%
Al ₂ O ₃	40 - 45%
Fe ₂ O ₃	.9 - 1.13%
CaO	.10 - .25%
MgO	.15 - .25%
TiO ₂	.5 - 1.90%
Alk.	.4 - 1.12%
App. Porosity	13 - 17%
P.C.E.	32 - 33
Wt. Per Cu. Ft.	140 - 145

Thermal Conductivity at 2000°F.
B.T.U./Hr./Sq. Ft./In./°F. = 9 - 12
Reversible Linear Ex. 900°C. = .42 - .58%

SD-2	
SiO ₂	56 - 60%
Al ₂ O ₃	36 - 40%
Fe ₂ O ₃	.9 - 1.10%
CaO	.10 - .25%
MgO	.15 - .20%
TiO ₂	.5 - 1.85
Alk.	.4 - 1.00
App. Porosity	32 - 33
P.C.E.	13 - 17
Wt. Per Cu. Ft.	140 - 158

Thermal Conductivity at 2000°F.
B.T.U./Hr./Sq. Ft./In./°F. = 9 - 12
Reversible Linear Ex. 900°C. = .50 - .68%

Courtesy: W. L. Fabianic, Laclede Christy Co.,
Div., H. K. Porter Co.,
Ceramic Industry, 1955

Regular Clay Flux Block

The term "regular clay flux" as used here refers to an alumina silica clay mixture type of bonded and kiln burned block ranging in chemical composition and physical properties as follows.

SiO ₂	74 - 60%
Al ₂ O ₃	23 - 34%
Fe ₂ O ₃	2 - .9%
CaO	.40 - .10%
MgO	.30 - .15%
TiO ₂	2.4 - .50%
Alk.	1.0 - .40%
P.C.E.	29 - 32
App. Porosity	17.5 - 27%
Wt. Per Cu. Ft.	120 - 134

Thermal Conductivity at 2000°F.
B.T.U./Hr./Sq. Ft./In./°F. = 10 - 13
Reversible Linear Ex. 900°C. = .66 - .82%

Courtesy: W. L. Fabianic, Laclede Christy Co.,
Div., H. K. Porter Co.,
Ceramic Industry, 1955

Fusion Cast Block

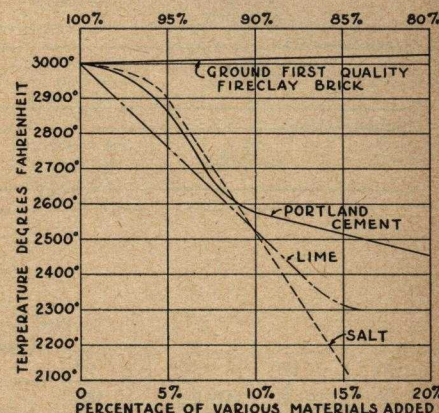
By fusion cast block is meant the many types made by first melting the raw materials into a hot magma and then pouring into the desired shapes while hot. Upon cooling, the block are ready for use and need no burning in a kiln. These block range in chemical composition and physical properties as follows:

SiO ₂	1 - 22%
Al ₂ O ₃	48 - 94%
Fe ₂ O ₃	.10 - .25%
CaO	.10 - .35%
MgO	.10 - .35%
TiO ₂	.05 - 2.5%
Cr ₂ O ₃	0 - 8%
ZrO ₂	6 - 40%
Na ₂ O	1.2 - 5.8%
Lbs. Cu. Ft.	180 - 210
App. Porosity	Near Zero to 7%
P.C.E.	Over 3410°F.

Thermal Conductivity at 2000°F.
B.T.U./Hr./Sq. Ft./In./°F. = 18 - 30
Reversible Thermal Ex. 900°C. = .40 - .63%

Courtesy: W. L. Fabianic, Laclede Christy Co.,
Div., H. K. Porter Co.,
Ceramic Industry, 1955

Fusion Points of Mixtures of a Plastic Fireclay and Other Materials



Checked 1956 by Harbison-Walker
Refractories Co.

Reaction Temperatures Between Different Refractories

Type of Refractory Brick	High Duty Fireclay Brick	Forsterite	Degrees Fahrenheit 70% Al ₂ O ₃	High-Alumina 90% Al ₂ O ₃	Magnesite Fired	Magnesite-Chrome Chemically Bonded	Silica
Chrome Fired	**2910 x3000	**2910 xx3000	**2910 xx2910	**3000 x3100	*3000 **3100 x3100	*3100	**3000 *3000
Chrome-Magne- site Chemi- cally Bonded or Fired	**2910 x3000	*3000 **3100 x3100	**2910 x3000 xx3100	**3000 x3100			**2910 x3000
Fireclays High-Duty		**2730 xx2910	*3000	*3000	**2550 xx2730		**2730 xx2910
Forsterite			**3000 x3000 xx3100	**3000 x3000 xx3100	*3000 **3100 xx3100	*3000 **3100 x3100	**3000 x3000
High-Alumina 70% Al ₂ O ₃					**2730 x3000 xx3100	**2910 x3000 xx3100	**2910 x3000
High-Alumina 90% Al ₂ O ₃					**2910 xx3000	**2910 x3100	**3000 x3000
Silica					**2730 xx2910	*2910 xx3000	

*No Reaction

**Reaction First Observed

xReaction slight

xxReaction damaging.

Courtesy, Harbison-Walker Refractories Co. Checked 1956

Physical and Chemical Properties of Ten Ceramic Refractories

Continued on opposite page

(1) Material	(2) Specific Gravity	(3) Melting Point °C. & °F.	(4) Hardness Mohs Scale	(5) Mean Specific Heat Cal/gm/°C. Btu/lb./°F.	(6) Thermal Conductivity Btu/hr/ft ² in./°F.	(7) Thermal Expansion xx10 ⁻⁶
Alumina—(Al ₂ O ₃)	4.0	2050° C. 3722° F.	9.0	20°-1000° C. 0.304	2400° F. 30.0	25°-800° C. 8.5
Beryllia—(BeO)	3.0	2570° C. 4658° F.	9.0	900° C. 0.497	High	25°-1260° C. 9.2
Magnesia—(MgO)	3.5	2800° C. 5072° F.	6.0	30°-1100° C. 0.283	2012° F. 40.8	20°-1800° C. 13.4
Silicon Carbide—(SiC)	3.17	2700d° C. 4892d° F.	9.0-10.0	1000° C. 0.1216	2012° F. 70.7-121.8	0°-1700° C. 4.3 4.7
Thoria—(ThO ₂)	9.69	3030° C. 5486° F.	7.0	25° C. 0.06	Very low	25°-800° C. 9.5
Zirconia—(ZrO ₂)	5.6	2720° C. 4928° F.	Fused 8.5 Sintered 7.0	25°-1000° C. 0.157	2400° F. 14.3	0°-1400° C. 5.0
Zircon—(ZrO ₂ SiO ₂)	4.7	Incong 2550° C. 4622° F.	8.0	36° C. 0.131	11.6	20°-700° C. 4.9
Spinel—(MgO.Al ₂ O ₃)	3.53	2135° C. 3875° F.	8.0	50°-1025° C. 0.290 0°-1042° F. 0.257	2400° F. 14.6	25°-800° C. 8.5
Graphite—(C)	2.25	3527° C. 6380° F.	0.5-1.0	26°-76° C. 0.165 56°-1450° C. 0.390	400° F. 730.0 2000° F. 220	25°-40° C. 7.8
Carbon—(C)	1.8-2.1	Sublimes 3537° C. 6399° F.		26°-76° C. 0.168 56°-1450° C. 0.387	1600° F. 18.5 2000° F. 22.0	500° C. 1.5-5.5

Comparison of Kiln Firing Costs in Tunnel Kilns

	(1) Million Btu per Unit of Fuel	(2) Units of Fuel per M Brick (a)	(3) Million Btu per M Brick (a)	(4) Fuel Cost per Unit of Fuel	(5) Fuel Cost per Million Btu (f)	(6) Kiln Labor Cost per Million Btu (a)	(7) Power and Heating Cost per Million Btu	(8) Investment Charges per Million Btu (a)	(9) Total Firing Cost per Million Btu	(10) Total Firing Cost per M Brick
Bituminous Coal in Gas Producers in Tunnel Kilns	26 per NT	.75 NT(c)	19.5	\$ 5.00 per NT 6.00 per NT 7.00 per NT 8.00 per NT 10.00 per NT	\$.193 .232 .269 .308 .385	\$.067(b) .067 .067 .067 .067	Gasification(e) \$.09 plus Kiln power \$.045 or \$.136	\$.042 .042 .042 .042 .042	\$.438 .477 .514 .553 .630	\$ 8.54 9.36 10.02 10.78 12.29
Anthracite or Coke in Gas Pro- ducers in Tunnel Kilns	24 per NT	.86 NT(c)	20.6	\$ 5.00 per NT 6.00 per NT 7.00 per NT 8.00 per NT 10.00 per NT 12.00 per NT	\$.208 .25 .292 .333 .417 .50	\$.056 .056 .056 .056 .056 .056	Gasification(e) \$.08 plus Kiln power \$.045 or \$.125	\$.035 .035 .035 .035 .035 .035	\$.424 .466 .508 .549 .633 .716	\$ 8.73 9.60 10.46 11.31 13.04 14.75
Fuel Oil Distillate #2 or #3	.14 per gal.	111 gals.	15.5	\$.07 per gal. .08 per gal. .09 per gal. .10 per gal. .12 per gal.	\$.50 .573 .644 .716 .86	\$.053 .053 .053 .053 .053	Power for oil \$.02 plus kiln power \$.045 or \$.065	\$.016 .016 .016 .016 .016	\$.634 .707 .778 .850 .994	\$ 9.83(b) 10.96(b) 12.06(b) 13.18(b) 15.41(b)
Fuel Oil Residual #5 or #6 in Tunnel Kilns	.15 per gal.	103 gals.	15.5	\$.06 per gal. .07 per gal. .08 per gal. .09 per gal. .10 per gal. .12 per gal.	\$.40 .467 .533 .60 .667 .80	\$.056 .056 .056 .056 .056 .056	Power and heat for oil \$.035 plus kiln power \$.045 or \$.08	\$.03 .03 .03 .03 .03 .03	\$.566 .633 .699 .766 .833 .966	\$ 8.77(c) 9.81(c) 10.83(c) 11.87(c) 12.91(c) 14.97(c)
Natural Gas in Tunnel Kilns	1 per M cu. ft.	16M cu. ft.	16	\$.15 per MCF .20 per MCF .25 per MCF .35 per MCF .50 per MCF	\$.15 .20 .25 .35 .50	\$.05 .05 .05 .05 .05	kin power	\$.007 .007 .007 .007 .007	\$.252 .302 .352 .452 .602	\$ 4.03 4.82 5.63 7.23 9.63

(a) Must be adjusted to suit the particular plant, kiln and fuel under consideration.

(b) (Same as Table I).

(c) (Same as Table I).

(d) Includes investment charges on Fuel equipment only but not on investment in tunnel kiln.

(e) Gasification cost includes gas producer labor, steam and supplies. Depreciation is included under investment charges.

(f) Does not include steam coal, for gas producer plant. This is included in Col. (7).

Dwight B. Hendryx, Consultant, Pittsburgh, Pa.

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Physical and Chemical Properties of Ten Ceramic Refractories (continued from opposite page)

(8) Thermal Shock Resistance	(9) Modulus of Elasticity #/in. ²	(10) Tensile Strength at 25° C. #/in. ²	(11) Compressive Strength at 25° C. #/in. ²	(12) Transverse Strength at 25° C. #/in. ²	(13) Resistance to Abrasion	(14) Resistance to Chemical Corrosion	(15) Resistance to Oxidation by air	(16) Resistance to Reduction by carbon	(17) Cost per Pound Approx. Dollars
Good	5.24x10 ⁷	35,800	412,500	46,800	Good	Acid Alkali HF	Not affected	Attacked by amor- phous carbon at M.P. but not read- ily by graphite	.055
Very good	4.28x10 ⁷	13,800	103,100	20,600	Good	Alkali	Not affected	Not affected	4.00
Fair	1.24x10 ⁷				Very poor	Alkali	Not affected	Slightly reduced at 1450° C. Rapidly reduced above 2000 C.	.05
Good					Very good	Reacts readily with basic fluxes	Dissociates at 2200° C. Dissociates at 2240° C.	Not affected	.15-.20
Fair	1.79x10 ⁷		220,000	17,900	Good	Basic	Not affected	Reduced by carbon at high temperature	7.00
Fair	2.48x10 ⁷	17,900	302,500	26,100	Good	Acid and neutral material	Not affected	Forms carbides at high temperature	.90
Very good	2.40x10 ⁷	12,700	90,000	25,000	Good	Acid HF	Not affected	Decomposes above 1900° C.	.12
Fair	3.17x10 ⁷	18,600	247,500	24,100	Good	Acid bases	Not affected	Not readily reduced-	
Very good	Plain .14x10 ⁷ Impervious .22x10 ⁷	Plain 800 Impervious 2400	Plain 5500 Impervious 10,000	Plain 2800 Impervious 4800	Poor	Chemically Inert	Oxidizes in air appre- ciably at 640° C.	Not affected	C.P. .50-.75
Very good	Plain .19x10 ⁷ Impervious .28x10 ⁷	Plain 900 Impervious 1800	Plain 7000 Impervious 10,500	Plain 2700 Impervious 4400	Good	Chemically Inert	Oxidizes in air appre- ciably at 640° C.	Not affected	C.P. .25-.45

Comparison of Kiln Firing Costs in Periodic Kilns

	(1) Million Btu per Unit of Fuel	(2) Units of Fuel per M Brick (a)	(3) Million Btu per M Brick (a)	(4) Fuel Cost per Unit of Fuel	(5) Fuel Cost per Million Btu	(6) Kiln Labor Cost per Million Btu (a)	(7) Power and Heating Cost per Million Btu	(8) Investment Charges per Million Btu	(9) Total Firing Cost per Million Btu	(10) Total Firing Cost per M Brick
Fuel										
Bituminous Coal Hand Fired in Periodic Kilns	26 per NT	1.6 NT	42	\$ 5.00 per NT 6.00 per NT 7.00 per NT 8.00 per NT 10.00 per NT	\$.193 .232 .269 .308 .385	\$.12 .12 .12 .12 .12	None None None None None	None None None None None	\$.313 .352 .389 .428 .505	\$13.15 14.78 16.34 17.93 21.21
Bituminous Coal Stoker Fired in Periodic Kilns	26 per NT	1.3 NT	34	\$ 5.00 per NT 6.00 per NT 7.00 per NT 8.00 per NT 10.00 per NT	\$.193 .232 .269 .308 .385	\$.128* .128* .128* .128* .128*	\$.011 .011 .011 .011 .011	\$.028 .028 .028 .028 .028	\$.360 .399 .436 .475 .552	\$12.24 13.57 14.82 16.15 18.77
Fuel Oil Distillate #2 or #3 in Periodic Kilns	.14 per gal.	228 gals.	32	7c per gal. 8c per gal. 9c per gal. 10c per gal. 12c per gal.	\$.50 .573 .644 .716 .86	\$.033 .033 .033 .033 .033	\$.007 .007 .007 .007 .007	\$.017(b) .017(b) .017(b) .017(b) .017(b)	\$.557(b) .63 .701 .773 .917	\$17.82(b) 20.16(b) 22.43(b) 24.74(b) 29.34(b)
Fuel Oil Residual #5 or #6 in Periodic Kilns	.15 per gal.	213 gals.	32	6c per gal. 7c per gal. 8c per gal. 9c per gal. 10c per gal. 12c per gal.	\$.40 .467 .533 .60 .667 .80	\$.036 .036 .036 .036 .036 .036	\$.018 .020 .021 .023 .025 .028	\$.03(c) .03(c) .03(c) .03(c) .03(c) .03(c)	\$.484 .553 .62 .689 .758 .894	\$15.49(c) 17.70(c) 19.84(c) 22.05(c) 24.26(c) 28.61(c)
Natural Gas in Periodic Kilns	1 per M cu ft.	33M cu. ft.	33	15c per MCF 20c per MCF 25c per MCF 35c per MCF 50c per MCF	\$.15 .20 .25 .35 .50	\$.031 .031 .031 .031 .031	None None None None None	\$.006 .006 .006 .006 .006	\$.187 .237 .287 .387 .537	\$ 6.17 7.82 9.47 12.77 17.72

(a) Must be adjusted to suit the particular plant, kiln and fuel under consideration. Base labor rate taken as \$1.15 per hour.

(b) These figures based upon using distillate oil 12 months per year. If used as standby fuel for 4 months, investment charges become \$.051 per million Btu and Total Cost is increased \$1.12 per M brick.

(c) These figures based upon using residual oil 12 months per year. If used as standby fuel for 4 months, investments charges become \$.09 per million Btu, and Total Cost is increased \$1.92 per M brick.

*This \$.128 figure for labor costs refers to stokers for kilns firing refractories. In firing kilns at lower temperatures (tile or building brick) the labor cost should be approximately \$.06.

Properties of Finished Refractories

PROPERTIES OF FINISHED REFRACTORIES												
BRICK	COMPOSITION	P.C.E. OR SOFTENING POINT	TRUE SPECIFIC GRAVITY	APPROX. WEIGHT 9 BRICK	POROSITY	LINEAR COEFFICIENT OF EXPANSION	THERMAL CONDUCTIVITY (C.G.S. UNITS)	SPECIFIC HEAT	(SIC-100) SPALLING INDEX	DEFORMATION UNDER LOAD (25# Sq. In.)	CONSTANCY OF VOLUME	SLAG RESISTANCE
ACID	High Heat Duty Fire Brick	Al ₂ O ₃ : 33-42% Si O ₂ : 52-60%	31-33 (3056-3173°F)	2.60-2.70	7.5-8#	15-24%		.254	60-80	3-10% (2462°F)	.5 to 2% Shrink. @ 2552°F.	Rapidly attacked by basic slags. Particularly those high in Fe ₂ O ₃ . Moderate resistance to acid slags.
	High Heat Duty Dry Press	Al ₂ O ₃ : 40-3% Si O ₂ : 55.0%	33	"	8.2#	18.6%	"	"	85	2.6% (2462°F)	.8% Shrinkage @ 2552°F.	Rapidly attacked by basic slags. Particularly those high in Fe ₂ O ₃ . Moderate resistance to acid slags.
	High Heat Duty Stiff Mud	Al ₂ O ₃ : 39-4% Si O ₂ : 56.0%	32%	"	8#	16%	"	"	80	3.5% (2462°F)	1.2% Shrinkage @ 2552°F.	Rapidly attacked by basic slags. Particularly those high in Fe ₂ O ₃ . Moderate resistance to acid slags.
	Super-Duty	Al ₂ O ₃ : 43-44% Si O ₂ : 51-53%	33-34	"	7.5-8#	12-16%	as high heat duty fire brick.	"	80-85	4-5% (2462°F)	1% Max. Shrink. @ 2300°F.	More resistant to most alkalies than fire brick. Readily attacked by Fe ₂ O ₃ .
	High Alumina	Al ₂ O ₃ : 50-60 70 or 80%	34-39 (3200-3385°F)	"	"	20-31%	"	"	60-80	Somewhat less than high heat duty fire brick.	"	"
	Kaolin	Al ₂ O ₃ : 44-45% Si O ₂ : 51-53%	31-34 (3056-3200°F)	"	"	18-28%	(200-1000°C) .0045	.254	75-85	1.0% @ 2600°F.	.5% Shrinkage @ 3000°F.	Approx. same as high heat duty fire brick. Slightly better resistance to alkalies.
	Sillimanite or Mullite	Al ₂ O ₃ : 60% Si O ₂ : 36%	38 (3335°F)	3.00	8.4#	15-22%	(600-900°C) .0044	.175	90	0.0% @ 2462°F. 1.0% @ 2900°F.	No Shrinkage @ 3000°F. 2.5% @ 3200°F.	Relatively insoluble in most slags & glasses, particularly those high in lime, alkalies, or fluorides. Attacked by strongly basic slags or those high in Fe ₂ O ₃ .
	Molten Cast Mullite	Al ₂ O ₃ : 71-72%	38 (3335°F)	3.00	10-10.25#	0.5% to 1%	(No temperature range given)	.25	50-60	No deformation @ 1350°C	No appreciable change 1593-1649°C.	Chem. characteristics of mullite; low porosity & high density. --Offer maximum resistance to corrosion.
	Zircon	Zr O ₂ . Si O ₂	Above 2550°C 4622°F	4.6	12#	20-26%	(200-1000°C) .0046	"	70-90	Failed at 1550°-1600°C	No appreciable change at 1550°C.	Slightly attacked by acid slags. Strongly attacked by basic slags & fluorides.
	Silica	SiO ₂ : 95-96	31-33 (3056-3173°F)	2.30-2.40	6#	22-30%	(200-1000°C) .0045	.265	10-30	0.0% @ 1500°C (500/Sq. In.)	Reversible expansion to 3173°F. No shrinkage.	Resists acid slags & dust. Attacked by basic slags, fluorides and Fe ₂ O ₃ .
NEUTRAL	Recrystallized Silicon Carbide	SiC: 98-99%	Dissociates at 2250°C. 4082°F	3.17	9#	20%	(200-1350°C) .0330	.225	100	0.0% @ 1500°C (500/Sq. In.)	No shrinkage @ 1500°C; up to 10% Pers. expansion due to oxidation.	Attacked by basic slags, particularly those high in iron oxide.
	Fused Alumina	Al ₂ O ₃ : 88-90%	2050°C. 3722°F.	3.90	11#	21%	(200-1000°C) .0035	.272	60-70	2% @ 1510°C (500/Sq. In.)	No shrinkage @ 1500°C.	Similar properties to P.B. Sillimanite
	Chrome	Cr ₂ O ₃ : 30-45% Al ₂ O ₃ : 15-33% Si O ₂ : 11-17% Fe O: 3-6%	1950-2200°C 3542-3992°F	3.80-4.10	11#	20-28%	(200-1000°C) .0040	.217	25-70	Improved chrome brick show no deformation @ 1425°C.	No shrinkage @ 1450°C. 1.3% @ 1550°C.	Neutral properties resistant to both acid and basic slags.
	Magnesite (Barned)	MgO: 83-93% Fe ₂ O ₃ : 2-7%	2200°C 3992°F	3.40-3.60	9.5#	20-28	(200-1000°C) .0087	.278	20-40	Not recommended where high heat strength reqd.	Shrinkage at Tem. above 1600°C	Highly resistant to basic slags. Readily attacked by acid slags.
	Magnesite (Unbarned)	"	"	"	10.5#	10-22%	"	"	30-50	3.5% Deformation @ 1460°C	Some shrinkage @ 1500°C. 2.6% @ 1550°C.	"
BASIC	Forsterite	2 MgO.Si O ₂	1910°C 3470°F	3.30-3.40	9#	24-27%	Slightly lower than Magnesite	"	20-40	Similar to silica.	Negligible shrinkage on reheat to 1650°C.	Similar to Magnesite but more readily attacked by either acid or basic slags.

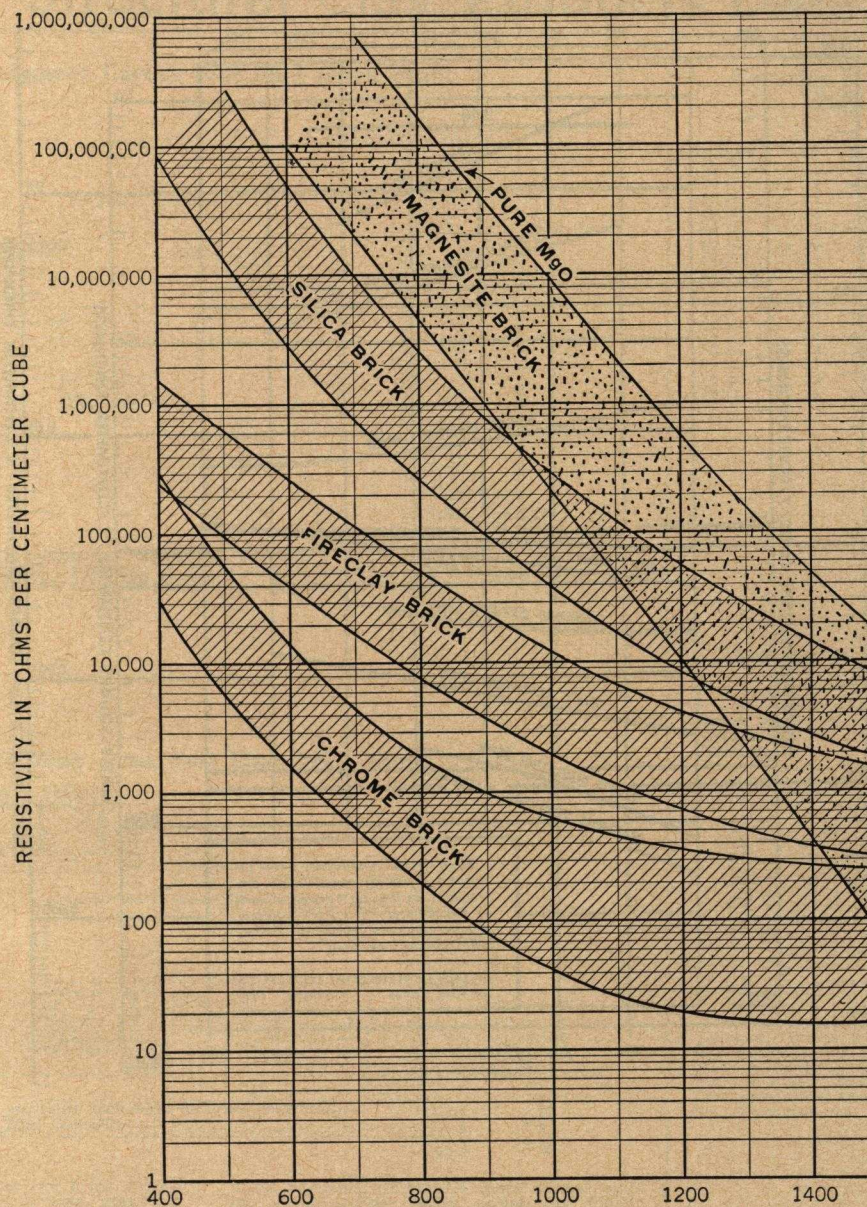
NOTE: To change C. G. S. units to B. T. U. per sq. ft. per 1' F. per inch thickness, multiply by 2933.

The Chas. Taylor Sons Co. Checked, 1956

The Chas. Taylor Sons Co. Checked, 1956

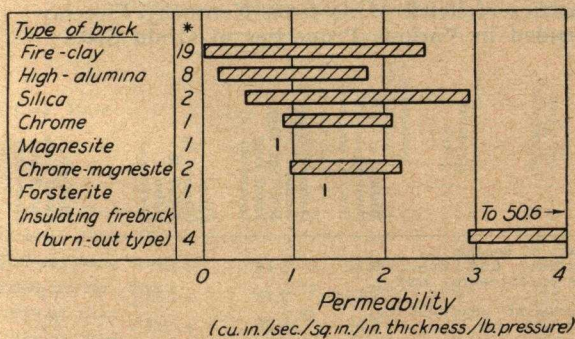
NOTE: To change C. G. S. units to B. T. U. per sq. ft. per 1" F. per inch thickness, multiply by 2903.

Approximate Electrical Resistivity of Refractory Brick



Courtesy, Harbison-Walker Refractories Co., 1956

Permeability to Air of Various Types of Fired Refractories



Star indicates number of brands tested.

Courtesy, BACS, July, 1948

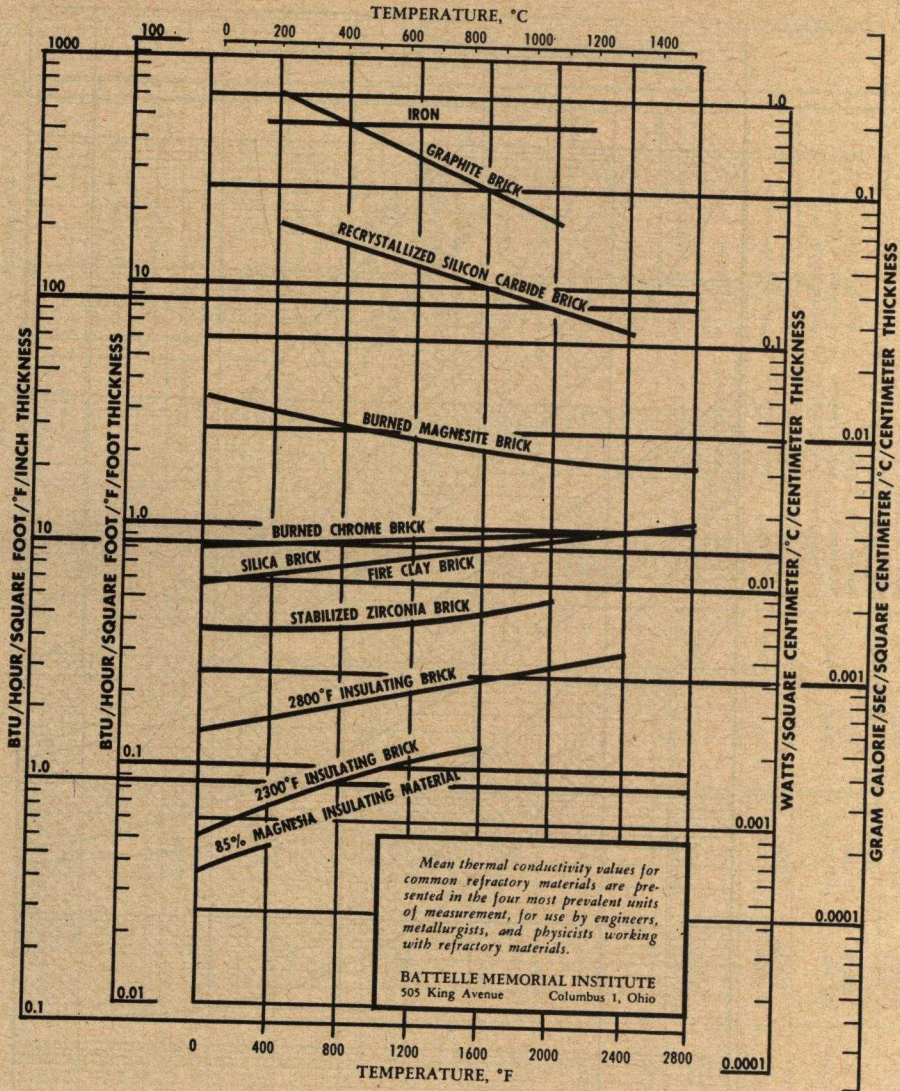
Specific Heats of Refractory Materials

t°C.	Mean Specific Heat Between 0°C. and t°C.— Fireclay Brick	Silica Brick	Magnesite Brick	Chrome Brick
0°	.193	.169	.208	.170
100°	.199	.189	.220	.177
200°	.205	.210	.232	.182
300°	.211	.230	.241	.183
400°	.213	.236	.248	.193
500°	.225	.245	.254	.198
600°	.231	.248	.260	.202
700°	.231	.252	.265	.206
800°	.244	.258	.269	.210
900°	.249	.262	.274	.213
1000°	.254	.266	.278	.217
1100°	.258	.269	.282	.220
1200°	.261	.272	.287	.222
1300°	.265	.275	.292	.224

The above figures appear to be the most probable values of the specific heats of refractory materials. They are based upon the work of various observers, whose data do not check with exactness.

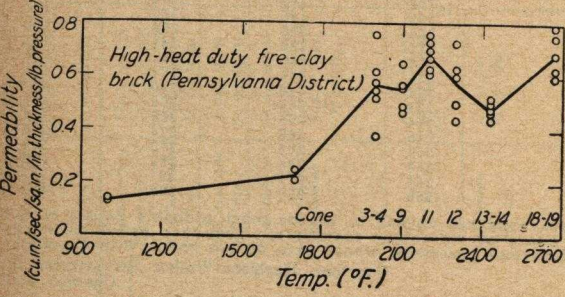
Courtesy, Harbison-Walker Refractories Co.
Checked 1956

Mean Thermal Conductivity Conversion Chart



Courtesy Battelle Memorial Institute
Checked 1956

Effect of Firing Temperature on Permeability
Of A Fireclay Brick



Checked 1956, by Harbison-Walker Refractories Co.

Properties of Brick Made from Kentucky Fireclay
Blended in Various Properties of Grain Sizes

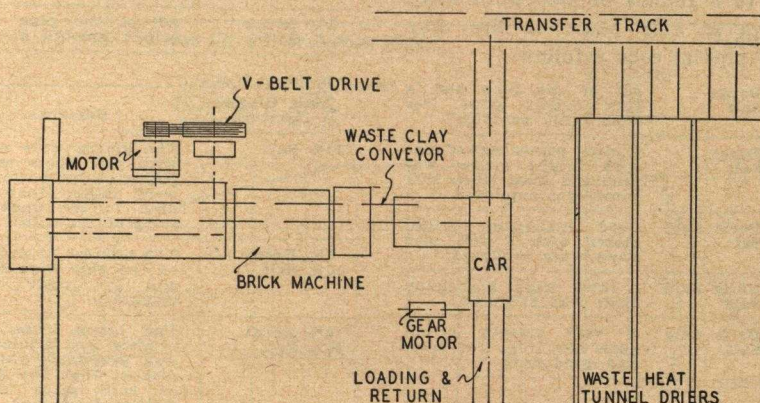
Mix	Bulk Density (oz. 1 sq. in.)	Deformation Under A.S.T.M. Hot Load Test (percent)	Linear Change in A.S.T.M. Reheat (percent)	Thermal Spall Loss A.S.T.M. (percent)
Equal part of coarse, intermediate and fine..	1.26	4.10	+1.70	10.7
Equal parts of coarse and fine	1.30	2.73	+1.35	7.6
Equal parts of intermediate and fine	1.30	5.40	+ .97	9.7

Courtesy, North American Refractories Co.
Checked 1956

Structural Clay Products Data

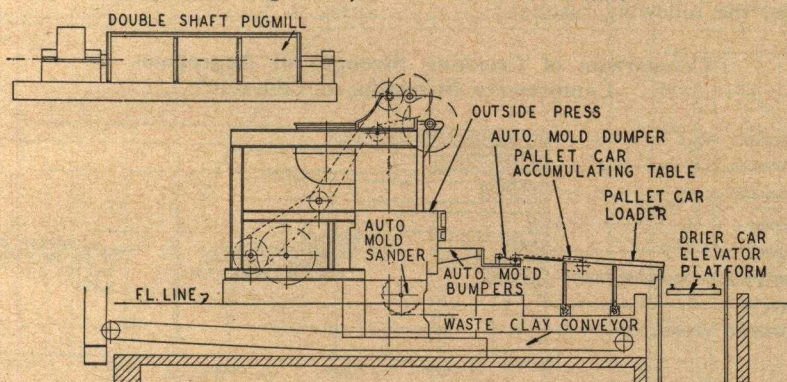
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Equipment Layout Soft Mud Brick Plant



Plan View shows equipment layout at Glen-Gery Shale Brick Corporation's Wyomissing, Pa., plant. Relation of the AutoBrik machine and the car loading station and track to the transfer track dryer entrance is shown.

Forming Area, Soft Mud Brick Plant



Elevation drawing shows the brick forming operation at the Wyomissing plant of Glen-Gery Shale Brick Corp. Shown are the shale preparation area with its pugmill, the

brick machine, automatic mold sander, pallet accumulating table, pallet car loader and the drier car on the elevator platform.

Optimum Sintering Conditions for Various Materials

Clay Type	Rate of Grate Travel (ft. per min.)	Average Duct Air Temperature (degrees F.)	Static Pressure (in. of water)	Optimum Air Flow (cu. ft./min.)	Coke Addition (% by wt.)	Tempering Water (% by wt.)	Pellet Type
Triassic Shale "A"	0.31	204	17.8	632	11	21.0	½-inch d.
Triassic Shale "B"	0.36	450	14.9	863	12	...	½-inch d.
Carbonaceous Shale	0.31	392	18.5	712	6	22.4	½-inch d.
Precambrian Shale	0.31	360	20.5	610	12	15.1	½-inch d.
Alluvial Clay	0.31	490	12.8	1141	11	23.5	½-inch d.
Alluvial Clay	0.96	349	8.4	1283	13	23.5	Random size
Surface Clay	0.38	480	14.8	800	16	35.4	½-inch d.
Surface Clay	0.63	207	11.8	813	16	38.8	Random size
Shale "C"	0.34	395	18.4	258	13	20.8	½-inch d.
Shale "C"	0.96	157	10.0	1086	13	20.8	Random size

From investigations, using a Dwight-Lloyd type sintering machine, into the development of light-weight clay aggregates suitable for use in concrete—or clay-bonded

building blocks. Studies conducted by W. C. Bell and D. H. McGinnis, North Carolina State College, 1950 and 1951.

Capacity of Shale Planers in Tons Per Hour

Height	Depth of Cuts				
	¼"	½"	¾"	1"	1½"
25 ft.	14	28	42	56	70
30 ft.	17	35	53	70	87
35 ft.	21	42	63	83	104
40 ft.	24	48	72	97	121
45 ft.	28	56	84	112	140
50 ft.	31	62	93	128	159
55 ft.	36	72	108	143	179
60 ft.	40	80	120	160	200
65 ft.	44	88	132	176	220
70 ft.	49	98	147	195	244
75 ft.	53	106	159	212	265
80 ft.	58	116	174	231	289
85 ft.	63	125	188	250	313
90 ft.	67	135	202	269	336
95 ft.	73	145	218	290	363
100 ft.	78	155	233	310	388

Courtesy, Eagle Iron Works, Checked 1957

Average Production Rates for Sewer Pipe

Size of Pipe (diam. in. inches)	Production Rate (pipe per hr.)
4	700-1000
6	550-900
8	400-600
10	290-500
12	250-400
15	175-300
18	155-300
21	110-250
24	100-180
27	65-100
27 ex	60-100
30	60-100
30 ex	55-75
33	36-70
33 ex	28-60
36	30-50
36 ex	24-45

Notes: Rates given above are based on the assumptions that a good, experienced crew is working with moderately workable shale or clay. Information compiled through the courtesy of the W. A. Riddell Corp. and the Stevenson Co.

Checked 1956

Drying and Firing Time for Sewer Pipe

Pipe Size (diam. in inches)	Drying Time (in hours)	Firing Time (in hours)
4	72	32tk
4	72	48
6	72	48
6	72	32tk
8	72	48
10	72	48
12	72	72
15	120	112
18	120	124
21	120	144
24	120	144
27	168	144
27 ex	168	192
30	168	192
30 ex	168	192
33	168	192
33 ex	168	192
36	168	192
36 ex	168	192

Notes: ex indicates extra strength; tk indicates tunnel kiln firing and the times given for tunnel kiln firing indicate both firing and cooling time, or turnover time. The schedules shown are in use at the modern W. S. Dickey Clay Mfg. Co. plant at Pittsburgh, Kan.

Checked 1956

Effect of Borax in Salt Glazing (At 3 Sewer Pipe Plants)

At plant 1, sewer pipe were made from a shale body maturing at cones 2 and 3. Iron bearing materials in the shale produced a rough surface glaze. Pipe were fired in round coal-fired downdraft kilns having a straight flue system. Two shovels of salt were thrown in the fire boxes and the openings were closed with fresh coal. This was repeated in 20 minutes. After each second round the kiln was fired with coal alone to raise the temperature which dropped due to the salt glazing. This method was used until the draw trials showed a satisfactory glaze. Usually 4 rounds of salt were employed. At this plant borax and boric acid were mixed with the fine granular salt in varying amounts. The effect of borax and boric acid mixtures with salt on salt glazes produced at this plant on shale sewer pipe at cone 2 are given in the following chart:

Salt Glazing Mixture	Remarks
100% Salt	Glaze was bright but uneven in thickness and it also was rough due to "iron popping."
5% Borax 95% Salt	Glaze was of more uniform thickness and roughness from "iron popping" was reduced.
10% Borax 90% Salt	The glaze was smoother than that produced with 5% borax and the luster was improved.
15% Borax 85% Salt	The glaze was slightly better than that produced with 10% borax.
5% Boric Acid 95% Salt	The glaze developed less "pig skinning" and was smoother than that developed with an equal percentage of borax.
10% Boric Acid 90% Salt	The glaze developed was practically free from "pig skinning" and "iron popping."
15% Boric Acid 85% Salt	The glaze produced was similar to that produced with 10% boric acid.

At plant 2, clay containing small amounts of iron bearing mineral was used. It matured at cones 6 to 8. The down-draft, spoke flue kilns were stoker fired. In each round of salting, two shovels of salt and coal were

placed alternately in the hoppers. This was repeated when the hopper was empty. As in plant 1, the kiln was fired with coal alone after every second round to raise the temperature. Four to 5 rounds of salt were used. Results at this plant on fire clay sewer pipe at cone 6 follow:

10% Borax 90% Salt	All of the pipe had a very bright glaze free from "iron popping."
15% Borax 85% Salt	A lower percentage of pipe with bright glazes was produced than when 10% borax was employed.
5% Boric Acid 95% Salt	Good mahogany bright glazes with a few iron spots were produced.
10% Boric Acid 90% Salt	A thick bright mahogany glaze was produced.
15% Boric Acid 85% Salt	A very smooth bright glaze free from iron spots was produced.

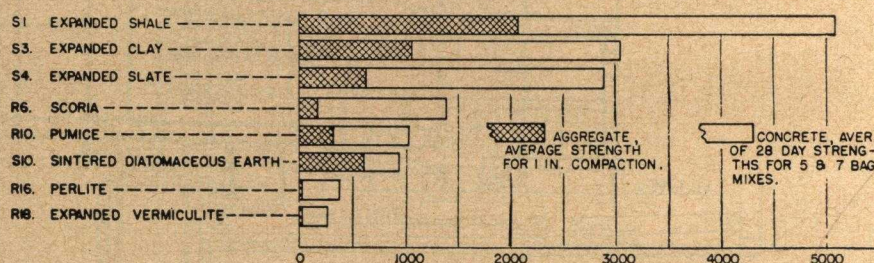
At plant 3 fire clay maturing at cones 8 to 10 was used. Down-draft kilns, with a spoke flue system, were gas fired. At each round two shovels of fine granular salt were placed in the fire box. One hour elapsed between saltings to regain kiln temperature. Five to 6 rounds of salt were used. Fire clay sewer pipe at cone 8 showed the following results:

Salt Glazing Mixture	Remarks
100% Salt	A portion of the pipe contained a bright glaze while others were dull and showed iron spots. Very little "pig skinning" was observed.
5% Borax 95% Salt	All of the pipe had a bright, smooth glaze.

Salt Glazing Mixture	Remarks
100% Salt	The glazes were mottled with dull spots and the glazes on the bottom pipe were duller than those fired in the upper portions of the kiln.
5% Borax 95% Salt	The number of dull spots on the pipe were reduced and the glaze became brighter.
10% Borax 90% Salt	The glaze was much brighter and a thick glaze was produced which indicated that the amount of salt glaze mixture might be reduced.
15% Borax 85% Salt	The glaze did not appear to be better than that produced with 10% borax.
5% Boric Acid 95% Salt	The glaze was slightly better than when 5% borax was used.
10% Boric Acid 90% Salt	The glaze was considered to be better and smoother than that produced with 10% borax.

From Schurecht and Wood research study at New York State College of Ceramics, Alfred, N. Y.

Comparison of Crushing Strength of Aggregates to Compressive Strengths of Concrete*



*Lightweight Aggregate Concretes, National Bureau of Standards for Housing and Home Finance Agency, Aug., 1949.

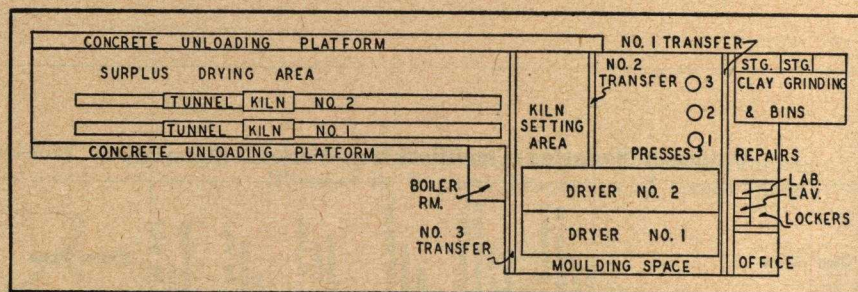
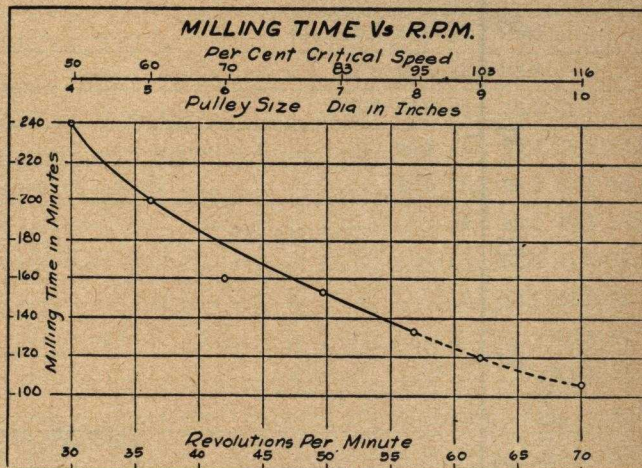
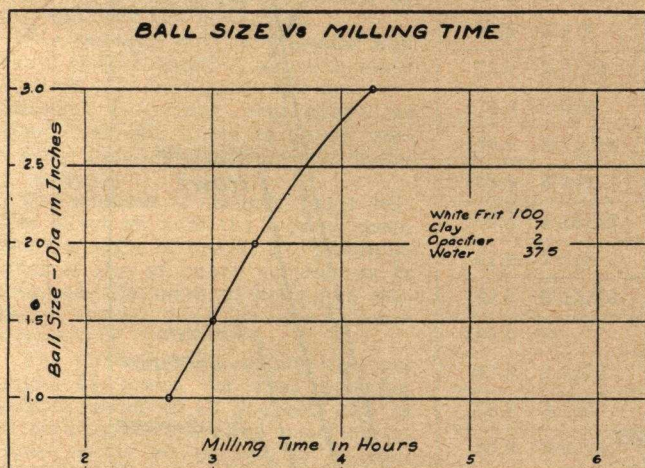
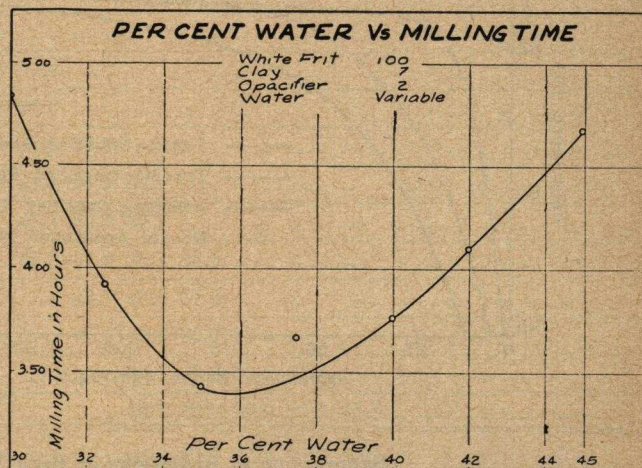
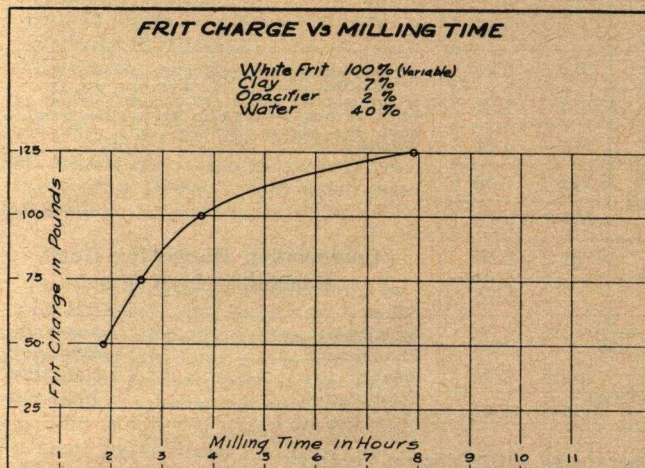


Diagram of Robinson Clay Product Co., Pottstown, Pa. plant shows how a minimum of space is used to coordinate the auger-press production and tunnel drying with the tunnel kiln firing of clay pipe.

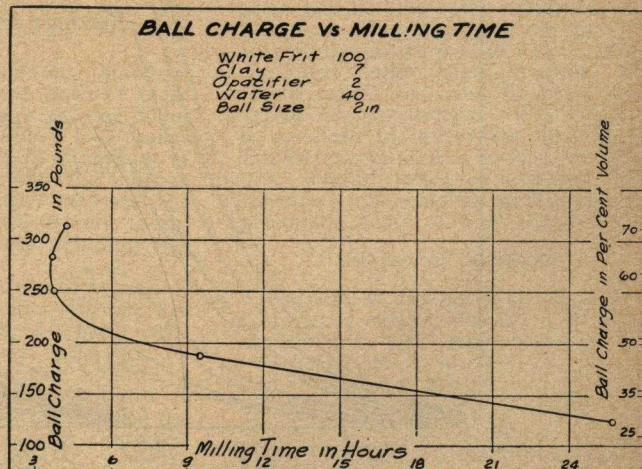
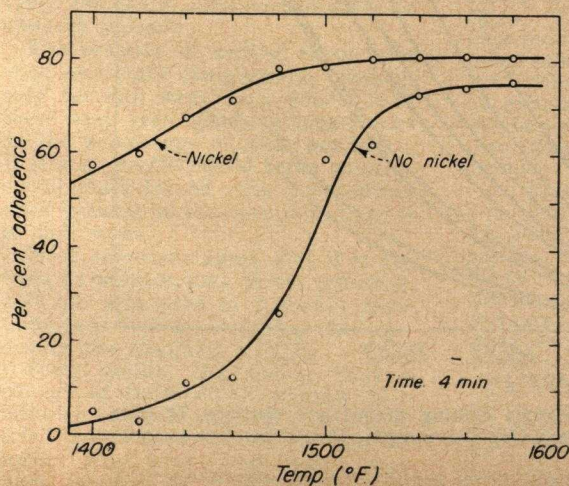
Porcelain Enameling

14

Milling of Porcelain Enamels



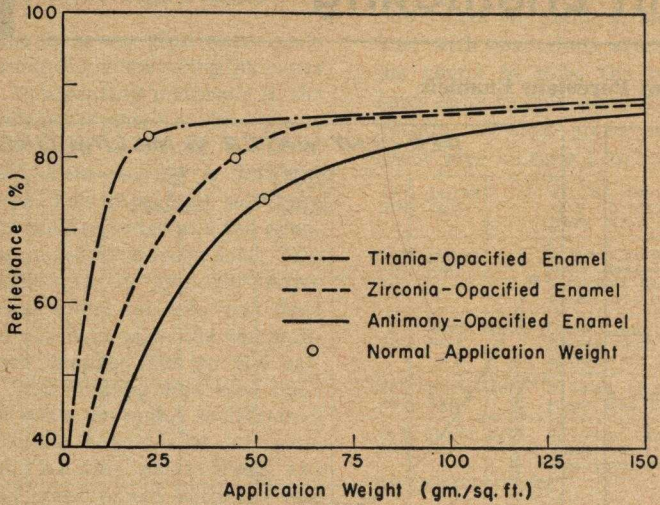
Ground Coat Adherence Values With and Without a Nickel Dip



Checked 1956 by Century Vitreous Enamel Co.

Checked 1956 by Century Vitreous Enamel Co.
From "Milling of Porcelain Enamels," by R. L. Fellows, "Better Enameling," March, 1949.

The Effect of Application Weight on Reflectance of Various Enamels



Checked 1956

Reflectance of Cast Iron Enamel

Thickness in Mils	Reflectance in Percent
96	84.8
81*	84.2
62**	83.5
46	81.8
36	79.4
32	77.3
23	72.3
16	62.3

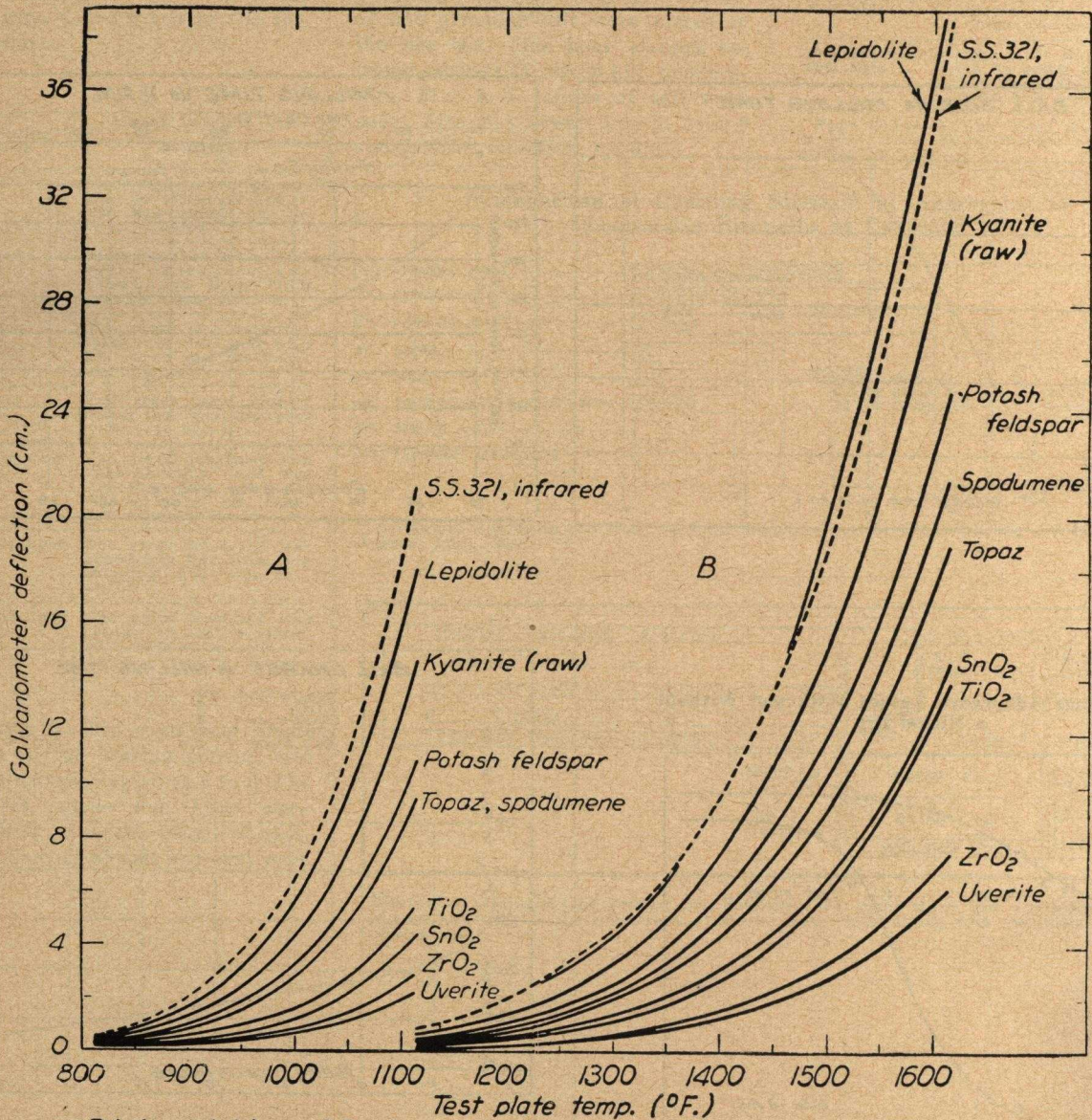
*application wt. 420 gms. per sq. ft.
**application wt. 340 gms. per sq. ft.
A commercial white dry process enamel applied to cast iron plates at various weights gave the above thickness and reflectance values.

Checked 1956

Composition Range for Good Enameling Cast Iron

Silicon	2.25-3.0%
Manganese	0.45-0.65%
Phosphorous	0.60-0.95%
Sulphur	0.05-0.10%
Total Carbon	3.25-3.60%

Suppression of Radiations at High Temperatures with Ceramic Coatings



Relative emissivity in infrared range (0.7 to 1.2 μ) for various coating materials; coatings 14 mils thick; (A) low-temperature range; (B) high-temperature range; measuring instrument adjusted between ranges.

Galvanometer deflection is directly proportional to the intensity of radiation. Lower galvanometer deflection means more radiation suppression.

Checked by University of Illinois, Dept. of Ceramic Engineering, 1953

The Operation of Ball and Pebble Mills

The principal elements involved in the operation of ball and pebble mills are:

- Speed of Mill
- Quantity of Balls
- Size of Balls
- Quantity of Material
- Consistency of Material (when wet grinding)
- Initial Particle Size

The sequence of the listing has no bearing on the item's relative importance—each element rates equal consideration.

Speed of Mill

There is a distinct relationship between critical and operating speed, but only as long as the other elements of grinding are kept under control.

Absolute critical speed is that speed at which the balls, without material, are held to the periphery of the mill by centrifugal force.

The operating speed controls the angle of break, which is that angle formed by a line joining the point where the outer layer of balls break from the periphery, to the center of the mill, and the horizontal.

For example, a 24-in. diameter mill has a critical speed of approximately 54 RPM. In starting a mill and continually increasing the speed of revolution, the angle of break constantly increases until critical speed is reached.

The addition of material has a definite effect on both the critical speed and the angle of break. For example, when a slip of heavy consistency is involved, the mass of balls and material carries over at much lower speeds.

For virtually all grinding, the best angle of break for fast grinding should be about 50 degrees, and to attain this, the operating speed should equal 55 to 60 percent of critical. Most commercial mill speeds come within this range.

Ball and Pebble Charge

The ball charge should at least half fill the mill. Most operators prefer to go on a little beyond the halfway mark to compensate for wear, and best practice concurs with this, provided the extra addition is limited to about 5 percent.

The practice of adding extra balls with each mill charging, to compensate for ball wear, is a good one if there have been some previous checks on the percentage of wear per batch. It is also good sense to make an occasional check for fill with a measuring stick because of the variations in rate of ball wear.

Most operators agree that it is the balls or pebbles that do the grinding, and the size used is probably more important than any exacting rule governing the quantity.

Some follow the theory that a charge of balls should consist of a mixture of sizes starting with 2½ or 3-in. diam. down to 1½ or 1¼ in. balls. Also, a few feel that a complete charge of 3 in. diam. balls should be used in a 5 ft. diameter

Water Content of Ground Coat Enamels

Water in ground coat enamel from wet and dry dip weights. Weight per sq. ft. of dry enamel (in grams and ounces).

Wt. Per Sq. Ft. of Wet Enamel	Grams	Ounces	28.5	30.3	32.1	33.8	35.6	37.4	39.2	41.0	42.8	44.5	46.3	48.1	49.9
Grams Ounces	1	1½	1¾	1⅞	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½
44.5	1-9/16	36.0	....	....	....	....	....	....	....	....	....	....	....	....	....
46.3	1-5/8	38.4	34.6	....	....	....	....	....	....	....	....	....	....	....	....
48.1	1-11/16	40.7	37.0	....	....	....	....	....	....	....	....	....	....	....	....
49.9	1-3/4	42.9	39.3	35.7	....	....	....	....	....	....	....	....	....	....	....
51.7	1-13/16	44.8	41.4	37.9	34.5	....	....	....	....	....	....	....	....	....	....
53.4	1-7/8	....	43.3	40.0	36.7	....	....	....	....	....	....	....	....	....	....
55.2	1-15/16	....	45.2	41.9	38.7	35.5	....	....	....	....	....	....	....	....	....
57.0	2	....	....	43.7	40.6	37.5	....	....	....	....	....	....	....	....	....
58.8	2-1/16	....	....	45.5	42.4	39.4	36.4	....	....	....	....	....	....	....	....
60.6	2-1/8	....	....	....	44.1	41.2	38.2	35.3	....	....	....	....	....	....	....
62.3	2-3/16	....	....	....	45.7	42.9	40.0	37.1	35.3	....	....	....	....	....	....
64.1	2-1/4	....	....	....	....	44.4	41.7	38.9	36.1	....	....	....	....	....	....
65.9	2-5/16	....	....	....	....	....	43.2	40.5	37.9	35.1	....	....	....	....	....
67.7	2-3/8	....	....	....	....	....	44.7	42.1	39.8	36.	....	....	....	....	....
69.5	2-7/16	....	....	....	....	....	....	43.6	41.0	38.5	35.9	....	....	....	....
71.3	2-1/2	....	....	....	....	....	....	45.0	42.5	40.0	37.5	35.0	....	....	....
73.0	2-9/16	....	....	....	....	....	....	....	43.9	41.5	39.0	36.6	....	....	....
74.8	2-5/8	....	....	....	....	....	....	....	45.2	42.9	40.5	38.2	35.7	....	....
76.6	2-11/16	....	....	....	....	....	....	....	....	44.2	41.9	39.6	37.2	34.9	....
78.4	2-3/4	....	....	....	....	....	....	....	....	45.5	43.2	40.9	38.6	36.4	....
80.2	2-15/16	....	....	....	....	....	....	....	....	....	44.4	42.2	40.0	37.8	....
81.9	2-7/8	....	....	....	....	....	....	....	....	....	....	43.5	41.3	39.1	....
83.7	2-15/16	....	....	....	....	....	....	....	....	....	....	44.7	42.6	40.4	....
85.5	3	....	....	....	....	....	....	....	....	....	....	....	43.8	41.7	....
87.3	3-1/16	....	....	....	....	....	....	....	....	....	....	....	....	44.9	42.9
89.1	3-1/8	....	....	....	....	....	....	....	....	....	....	....	....	....	44.0
90.8	3-3/16	....	....	....	....	....	....	....	....	....	....	....	....	....	45.1

Checked 1956

mill, working on the idea that the larger the mill, the larger the balls should be.

The weight of opinion, however, seems to disagree with both of these ideas. The proponents of the latter idea point out that every ball makes many contacts for each revolution of the cylinder. Increasing the number of grinding media will increase the number of these contacts and, therefore, must increase the grinding efficiency.

To further illustrate this point: A 3-in. ball weighs .9 lbs. There are 2.5 2-in. ball per lb.; 6 1½-in. balls per lb.; and 10 1¼-in. balls per lb. When the extra grinding surface a charge of smaller balls provides is compared to the lesser surface of the same weight of large balls, the higher efficiency is obvious.

For enamel frit grinding—which differs somewhat from most fine grinding operations by reason of the abrasive nature of the material and the large initial particle size—one manufacturer suggests starting with a mixture of 2-in. and 1½-in. diam-

eters and making later additions with 2-in. balls. This applies when the first cost of the entire mill of 1½-in. balls, combined with their shorter life might make the cost of their universal use prohibitive. The mixture is as close to uniformity in size as can be expected, and should give the best overall efficiency—taking into consideration grinding results and replacement costs of balls and linings.

Charge of Material

The size of the batch to be ground is, to some extent, controlled by plant conditions. Too large batches—on the order of three-quarters of the mill volume or greater occupied by the balls and charge of material—should be avoided, however. On enamel frit especially, the charge should just fill the voids and cover the balls. This is approximately a 25 percent charge which will grind about three times as fast as a 45 percent (mill ¾ full of material and balls) charge.

From a paper by O. H. Garlick of Paul O. Abbe, Inc., presented at the 12th Annual PBI Forum.

Table I
Properties of Titanium Oxide Slips and Enamels Made with Single Electrolytes

Slip No Electro- lyte	Bento- nite CW No Elec- trolyte	¼% Series						½% Series					
		KCl	K ₂ CO ₃	NaAlO ₂	NaNO ₂	MgCO ₃	KNO ₃	KCl	K ₂ CO ₃	NaAlO ₂	NaNO ₂	MgCO ₃	KNO ₃
Fineness gms./200 mesh	0.6	0.7	0.4	0.8	1.1	1.1	1.1	0.9	0.7	1.2	0.9	1.4	1.2
Na ₂ P ₂ O ₇ (sat.) cc.													
Specific gravity	1.726	1.730	1.730	1.733	1.726	1.730	1.732	1.730	1.731	1.731	1.730	1.729	1.725
Slump (Irwin) in.	10	8½	11¼	7¾	11½	10	10	6¾	9¾	7½	9¾	9¾	7½
Viscosity (Brookfield scale)	39	110	4	150	4	26	26	275	51	156	37	59	168
Firing (Comeback), 1500°/3 min.													
Reflectance—													
% Amber (A)	75.0	76.6	74.9	75.7	77.2	76.1	77.8	76.7	74.5	75.3	77.7	76.8	79.0
Blue (B)	83.2	82.9	81.1	81.9	82.0	83.0	83.9	82.3	80.1	82.0	82.9	83.0	83.2
Green (G)	77.0	77.9	76.1	77.1	78.8	77.9	79.0	78.1	76.5	77.0	79.1	78.2	80.1
Blue-Amber—													
Difference B-A	8.2	6.3	6.2	6.2	4.8	6.9	6.1	5.6	5.6	6.7	5.2	6.2	4.2
Color Value—													
B-A/G x 100	10.6	8.1	8.1	8.0	6.1	8.9	7.7	7.2	7.3	8.7	6.7	7.9	5.2
Firing (Comeback) 1520°/3 min.													
Reflectance—													
% Amber (A)	76.0	76.8	75.2	76.2	78.1	76.8	78.8	76.9	75.1	75.9	78.8	77.0	80.5
Blue (B)	83.0	82.1	81.0	81.8	82.1	83.2	83.7	82.0	79.8	81.3	82.8	83.0	83.2
Green (G)	78.0	78.2	77.0	78.0	79.7	78.8	80.1	78.1	76.8	77.7	80.2	79.0	81.6
Amber-Blue—													
Difference B-A	7.0	5.3	5.8	5.6	4.0	6.4	4.9	5.1	4.7	5.4	4.0	6.0	2.7
Color Value—													
B-A/G x 100	9.0	6.8	7.5	7.2	5.0	8.1	6.1	6.5	6.1	7.0	5.0	7.6	3.3
Color Stability—													
CV 1520/CV 1500	0.85	0.84	0.93	0.89	0.82	0.92	0.79	0.91	0.84	0.80	0.75	0.96	0.63

Courtesy, Edward E. Marbaker, Hollis S. Saunders and Leon N. Baumer, ACS

Checked 1956

Table II
Properties of Titanium Oxide Slips and Enamels Made with Combinations of Electrolytes

Slip No. Electrolyte	¼% KCl with						½% KCl with					
	Alone	¼% K ₂ CO ₃	¼% NaAlO ₂	¼% NaNO ₂	¼% MgCO ₃	¼% NaAlO ₂ ¼% MgCO ₃	Alone	¼% NaAlO ₂	¼% MgCO ₃	½% NaAlO ₂	½% MgCO ₃	½% NaAlO ₂ ½% MgCO ₃
Fineness, gms./200 mesh	0.7	1.2	1.0	0.5	0.9	1.3	0.9	1.3	1.2	0.9	1.3	0.9
Na ₂ P ₂ O ₇ (sat.) cc.												
Specific gravity	1.730	1.730	1.733	1.731	1.730	1.720	1.730	1.720	1.732	1.730	1.732	1.726
Slump (Irwin) in.	8½	8½	6¾	7¾	6¾	6¾	8½	6¾	7¾	6¾	8½	7¾
Viscosity (Brookfield scale)	110	118	257	158	242	222	162	275	90	160		
Firing (Comeback)—1500°/3 min.												
Reflectance—% Amber (A)	76.6	76.0	76.8	77.2	76.9	76.0	77.6	76.7	76.0	77.2	77.0	
Blue (B)	82.9	82.8	82.0	83.0	82.8	81.9	83.0	82.3	82.0	82.0	83.0	
Green (G)	77.9	77.3	78.0	79.0	78.6	78.0	79.0	78.1	77.2	78.2		
Amber-Blue Diff. B-A	6.3	6.8	5.2	5.8	5.9	5.9	5.4	5.6	6.0	6.0		
Color Value—B-A/G x 100	8.1	8.8	6.7	7.3	7.6	7.6	6.8	7.2	7.8	7.7		
Firing (Comeback)—1520°/3 min.												
Reflectance—% Amber (A)	76.8	77.2	77.5	77.8	76.9	77.0	78.3	76.9	76.3	77.2		
Blue (B)	82.1	82.2	81.0	83.0	82.8	81.0	82.8	82.0	81.9	82.0		
Green (G)	78.2	78.2	78.8	79.2	78.6	78.2	79.4	78.2	77.8	79.0		
Amber-Blue Diff. B-A	5.3	5.0	3.6	5.2	5.0	4.0	4.5	5.1	5.6	4.8		
Color Value—B-A/G x 100	6.8	6.4	4.5	6.6	6.4	5.1	5.7	6.5	7.2	6.1		
Color Stability—CV 1500/CV 1500	0.84	0.73	0.67	0.90	0.84	0.68	0.83	0.91	0.93	0.79		

Courtesy, Edward E. Marbaker, Hollis S. Saunders and Leon N. Baumer, ACS

Checked 1956

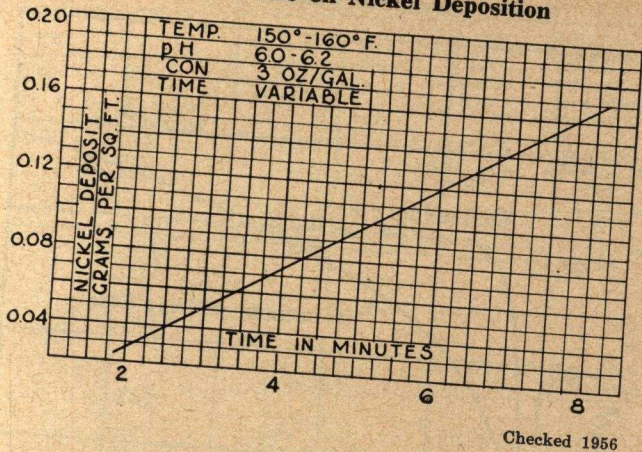
Table II (b)

Slip No. Electrolyte	¼% KCl with			¼% NaAlO ₂ with			½% NaAlO ₂ with		
	Alone	¼% NaAlO ₂	¼% MgCO ₃	Alone	¼% MgCO ₃	½% MgCO ₃	Alone	½% MgCO ₃	½% NaAlO ₂ ½% MgCO ₃
Fineness, gm./200 mesh	0.7	1.0	1.2	0.8	1.1	1.1	1.2	1.2	
Na ₂ P ₂ O ₇ cc.		2	5		6	3		8	
Specific gravity	1.730	1.728	1.730	1.733	1.731	1.731	1.731	1.731	
Slump (Irwin) in.	8½	7½	7¾	7¾	7¾	8½	7½	7¾	
Viscosity (Brookfield scale)	110	232	100	150	187	116	156	212	
Firing (Comeback)—1500°/3 min.									
Reflectance—% Amber (A)	76.6	76.2	76.8	75.7	75.2	75.5	75.3	75.5	
Blue (B)	82.9	81.0	81.8	81.9	81.2	82.2	82.0	81.9	
Green (G)	77.9	78.0	78.0	77.1	77.0	78.1	77.0	77.4	
Amber-Blue Diff. B-A	6.3	4.8	5.0	6.2	6.0	5.7	6.7	6.4	
Color Value—B-A/G x 100	8.1	6.2	6.4	8.2	7.8	7.3	8.7	8.3	
Firing (Comeback)—1520°/3 min.									
Reflectance—% Amber (A)	76.8	77.0	77.0	76.2	76.2	77.0	75.9	75.7	
Blue (B)	82.1	80.8	81.3	81.8	81.2	82.0	81.3	81.6	
Green (G)	78.2	78.0	78.2	78.0	78.0	78.5	77.7	77.4	
Amber-Blue Diff. B-A	5.3	3.8	4.3	5.6	5.0	5.0	5.4	5.9	
Color Value—B-A/G x 100	6.8	4.9	5.5	7.2	6.4	6.4	7.0	7.6	
Color Stability—CV 1520/CV 1500	0.84	0.79	0.86	0.89	0.82	0.88	0.80	0.92	

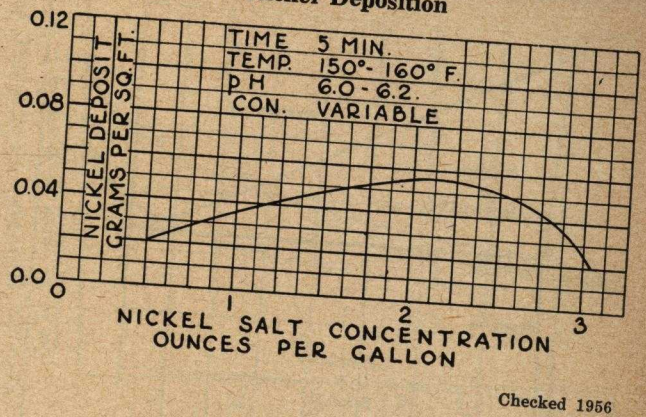
Courtesy, Edward E. Marbaker, Hollis S. Saunders and Leon N. Baumer, ACS

Checked 1956

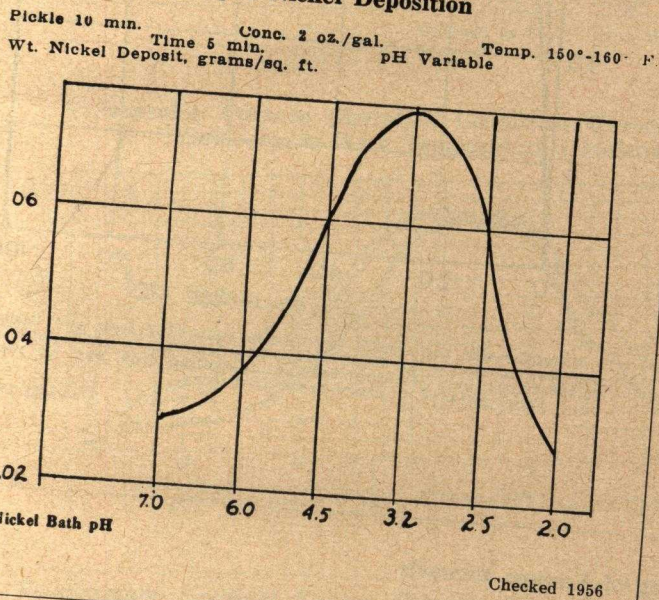
Effect of Time on Nickel Deposition



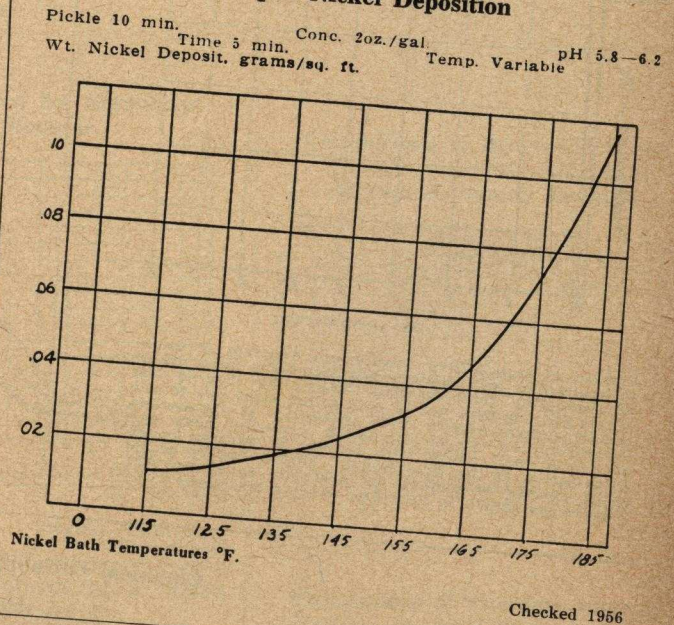
Effect of Nickel Salt Concentration on Nickel Deposition



Effect of Nickel Bath pH Values Upon Nickel Deposition



Effect of Bath Temperatures Upon Nickel Deposition

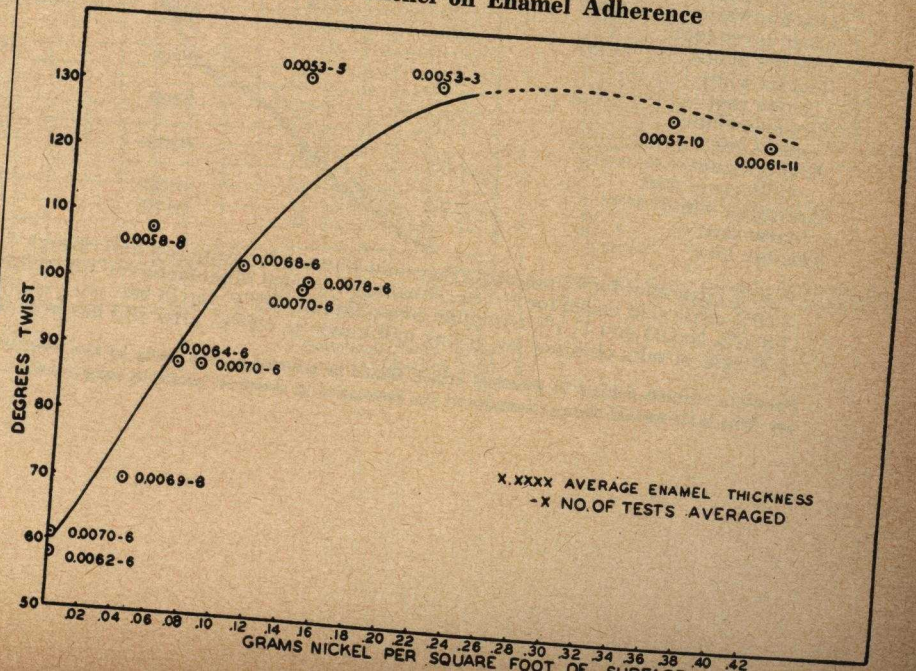


Sand Blast Operation

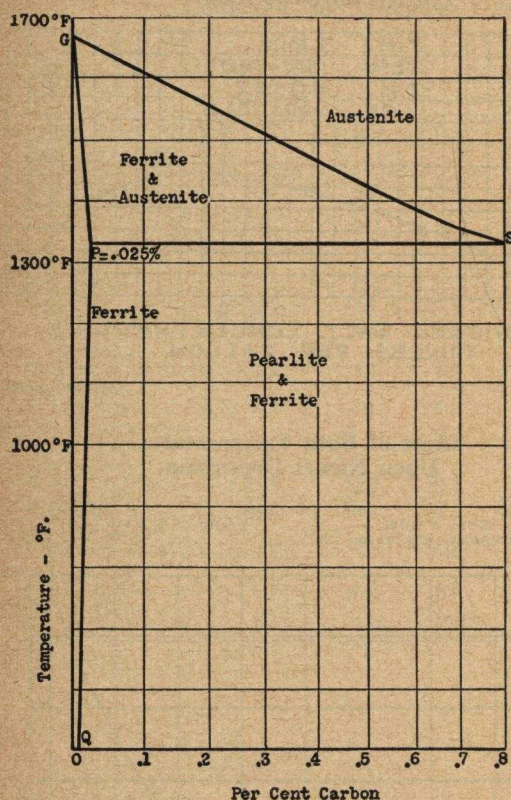
Gauge pressure	Nozzle	Air cu. ft. per min.
30	1/8"	22.5
	1/4"	40.0
	3/8"	62.89
	1/2"	90.0
	5/8"	123.0
40	1/8"	27.5
	1/4"	49.1
	3/8"	76.7
	1/2"	110
	5/8"	150
50	1/8"	32.8
	1/4"	58.2
	3/8"	90.7
	1/2"	130
	5/8"	178
60	1/8"	37.5
	1/4"	67
	3/8"	105
	1/2"	151
	5/8"	206
70	1/8"	43.9
	1/4"	76
	3/8"	119
	1/2"	171
	5/8"	233
80	1/8"	47.5
	1/4"	85
	3/8"	133
	1/2"	191
	5/8"	260

Checked 1956

Effect of Nickel on Enamel Adherence

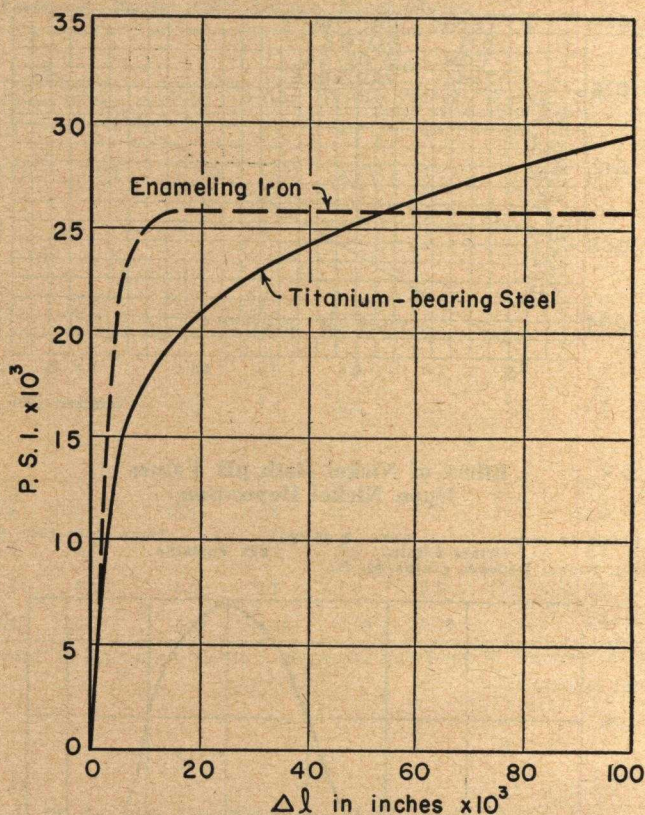


Portion of Iron-Carbon Equilibrium Diagram



Portion of iron-carbon equilibrium diagram is useful in explaining why some steels sag more than others at enameling temperatures. Enameling iron is less apt to deform than hot or cold rolled steel due to low carbon content (below 0.025 percent). If the carbon content is low—as in enameling iron—the piece can be heated well above 1600 degrees F. without much deformation of the base metal. Higher carbon steels allow change of pearlite to austenite at about 1333 degrees, as shown in diagram, causing warpage.

Strain Curves for Enamel Base Metals



Extensometer test strain curves for enameling iron and titanium-bearing enameling iron. Enameling iron has a yield point of 25,000-30,000 psi; titanium-bearing enameling iron has no yield point (note absence of sharp break in curve).

Checked 1956

Chemical Durability of Various Enamels

Enamel type	Firing temp. (°F.)	Reflectance (%) at 40 gm./sq. ft.	Acid resistance		Alkali resistance, solubility† (wt. loss in gm./sq. ft.)	Total solids (gm./liter)‡		
			Spot test*	Solubility† (wt. loss in gm./sq. in.)		0 hr.	24 hr.	1 week
One-fire white	1200	60	D	0.2900	0.183	35.440	68.815	93.76
One-fire white	1300	55	C	.1082	.153	10.560	14.805	18.65
Clear cover coat	"	30	A	.0024	.051	6.955	7.260	8.39
One-fire white	1500	70	C	.0150	.069	6.425	7.175	8.820
Titania white cover coat	"	82	A	.0016	.083	5.299	5.460	7.265
Zirconia white cover coat	"	73	C	.3390	.192	8.125	8.495	9.255
Acid-resistant white cover coat	"	60	AA	.0009	.036	3.760	4.170	5.780
Antimony white cover coat	"	70	C	.0130	.131	5.090	6.945	8.585
One-fire blue	"	"	B	.0110	.084	5.065	8.375	11.925

* 10% citric acid for 15 minutes (Porcelain Enamel Institute test and rating).

† 10% citric acid boiled for 2½ hr. (Enamelled Utensil Manufacturers' Council test).

‡ 8½% NaOH and 1½% trisodium phosphate at 180°F. for 18 hr.

§ Weight of salts obtained by drying mill liquor at 105°C. after slip has been aged for time indicated.

Porcelain enamels subject to chemical attack should be selected on the basis of the behavior of specific materials under a given end use. This table merely shows examples of the resistance to chemical attack of some enamels.

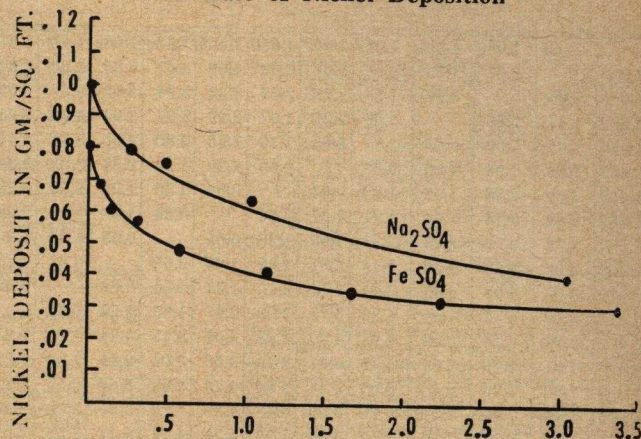
Checked 1956

Production Capacities of Porcelain Enameling Furnaces

SIZE	5 Ft. x 12 Ft. Box	7 Burner Continuous	9 Burner Continuous
PRODUCTION	400-500 per hr.	2000-3000	3000-4000
Sq. Ft. 20 ga. ware Cover Coat Burning	1:4 ware-tool ratio	1:1 ware-tool ratio	1:1 ware-tool ratio
HOLLOWWARE	500-700	2000-3500	3500-4000
Units per hour, 10 in. dia. x 5 in. Deep		80 ft. pre-heat	80 ft. pre-heat
CAST IRON	800-1000	3400-3800	4500-5000
Pounds per hour	Multiple Decking		
AVERAGE OIL CONSUMPTION	16-18	31-35	40-50
U. S. gal./hour 28° Baume			
AVERAGE GAS CONSUMPTION			
CFH			
1050 BTU	1500-1800	3000-3500	4000-5000
550 BTU	3000-3600	6000-7000	8000-10000
CHAIN SPEED			
Ft. per min.			
Cast Iron	2-500 lb. loads/hour	1½-2	2-3
Ground Coat 1580°	10 loads/hour	8-9	15-16
Cover Coat 1520°	14 loads/hour	10-14	18-24
HOT ZONE TRAVEL		40 feet	50 feet
AVERAGE LENGTH		82 feet	90 feet

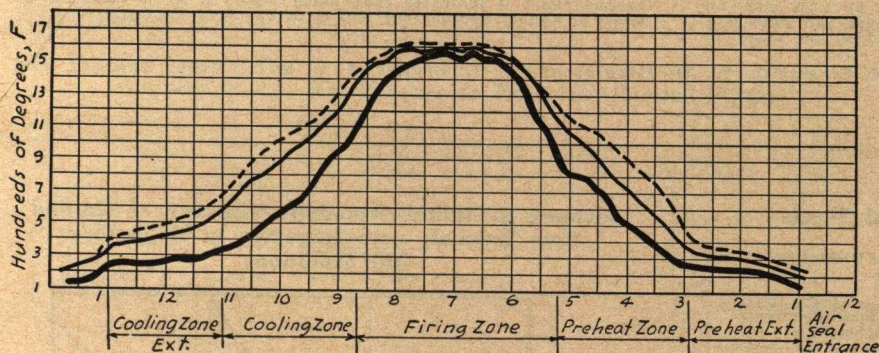
Checked by Ferro Corp., 1953

Effect of Iron and Sodium Sulphate Concentrations on Rate of Nickel Deposition



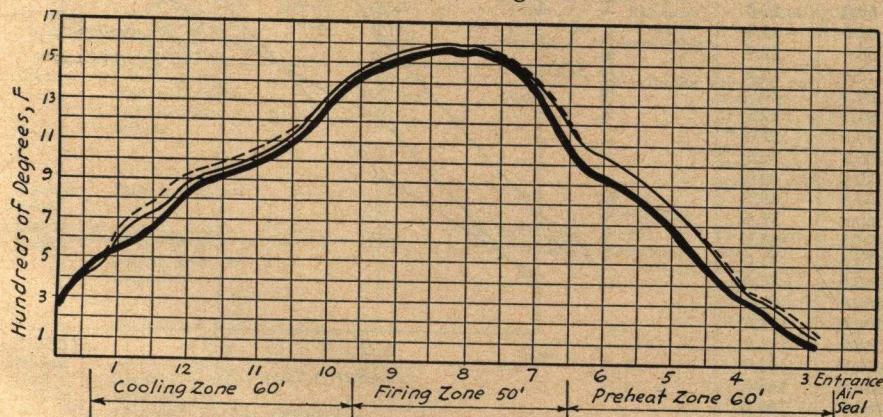
Courtesy J. M. Zander and O. C. Lihart, Chicago Vitreous Corp. Checked 1956

Unfavorable Furnace Operating Conditions Revealed by Significant Variations in Ware Temperature Gradient Records



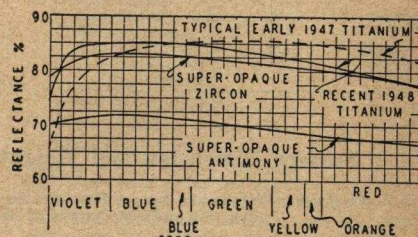
Courtesy, Ferro Corp. Checked 1956

Temperature Gradient Curves Showing Ware Temperatures at 3 Points and Indicating Favorable Operating Conditions in a Continuous Enameling Furnace



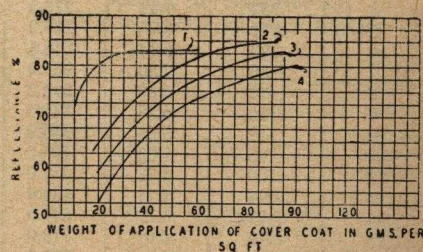
Courtesy, Ferro Corp. Checked 1956

Comparison of Recent Titanium Enamel with 1947 Titanium, Zircon, Antimony Enamels



A. L. Friedberg and F. A. Petersen Checked 1951

Comparison of Titanium Enamel Reflectance with That of Other Commercial Enamels



B. W. King, Ceramic Industry, Feb., 1949 Checked, University of Ill., 1951

Chart for Changing Specific Gravity of Slip*

Given in pounds of water per 10 gallons of slip

	1.625	1.630	1.635	1.640	1.645	1.650	1.655	1.660	1.665	1.670	1.675	1.680	1.685	1.690	1.695	1.700	1.705	1.710	1.715	1.720	1.725	1.730
1.625		0.67	1.33	2.00	2.67	3.33	4.00	4.67	5.33	6.00	6.67	7.33	8.00	8.67	9.33	10.0	10.7	11.3	12.0	12.7	13.3	14.0
1.630	0.66		0.66	1.32	1.98	2.64	3.31	3.96	4.63	5.30	5.95	6.62	7.27	7.95	8.60	9.26	9.92	10.6	11.2	11.9	12.6	13.2
1.635	1.31	0.66		0.66	1.31	1.97	2.62	3.28	3.94	4.60	5.25	5.91	6.56	7.22	7.88	8.54	9.20	9.85	10.5	11.1	11.8	12.4
1.640	1.95	1.30	0.65		0.65	1.30	1.95	2.60	3.26	3.91	4.56	5.21	5.86	6.51	7.16	7.81	8.46	9.12	9.77	10.4	11.1	11.7
1.645	2.58	1.94	1.29	0.65		0.65	1.29	1.94	2.58	3.23	3.88	4.52	5.17	5.82	6.46	7.11	7.76	8.40	9.05	9.70	10.3	11.0
1.650	3.20	2.56	1.92	1.28	0.64		0.64	1.28	1.92	2.56	3.20	3.85	4.48	5.13	5.77	6.41	7.06	7.69	8.34	8.98	9.62	10.3
1.655	3.82	3.18	2.54	1.91	1.27	0.64		0.64	1.27	1.91	2.54	3.18	3.82	4.45	5.09	5.74	6.36	7.00	7.64	8.27	8.91	9.55
1.660	4.42	3.79	3.16	2.53	1.90	1.26	0.63		0.63	1.26	1.90	2.53	3.16	3.79	4.42	5.06	5.69	6.32	6.95	7.59	8.22	8.85
1.665	5.02	4.39	3.76	3.14	2.51	1.88	1.25	0.63		0.63	1.25	1.88	2.51	3.14	3.76	4.39	5.02	5.65	6.27	6.90	7.53	8.16
1.670	5.60	4.98	4.36	3.74	3.11	2.49	1.87	1.24	0.62		0.62	1.24	1.87	2.49	3.11	3.74	4.36	4.98	5.60	6.23	6.85	7.47
1.675	6.18	5.56	4.94	4.33	3.71	3.09	2.47	1.85	1.24	0.62		0.62	1.24	1.85	2.47	3.09	3.71	4.33	4.94	5.56	6.18	6.80
1.680	6.75	6.15	5.52	4.91	4.29	3.68	3.07	2.45	1.84	1.23	0.61		0.61	1.23	1.84	2.45	3.07	3.68	4.29	4.91	5.52	6.15
1.685	7.31	6.70	6.09	5.48	4.87	4.26	3.65	3.04	2.44	1.83	1.22	0.61		0.61	1.22	1.83	2.44	3.04	3.65	4.26	4.87	5.48
1.690	7.86	7.26	6.65	6.05	5.44	4.84	4.23	3.63	3.02	2.42	1.81	1.21	0.60		0.60	1.21	1.81	2.42	3.02	3.63	4.23	4.84
1.695	8.40	7.80	7.20	6.60	6.00	5.40	4.80	4.20	3.60	3.00	2.40	1.80	1.20	0.60		0.60	1.20	1.80	2.40	3.00	3.60	4.20
1.700	8.94	8.34	7.76	7.15	6.56	5.96	5.36	4.77	4.17	3.58	2.98	2.38	1.79	1.19	0.60		0.60	1.19	1.79	2.38	2.98	3.58
1.705	9.46	8.86	8.28	7.69	7.10	6.51	5.92	5.33	4.73	4.14	3.55	2.96	2.38	1.77	1.18	0.59		0.59	1.18	1.77	2.38	2.96
1.710	10.0	9.40	8.81	8.22	7.64	7.05	6.46	5.88	5.29	4.70	4.11	3.53	2.94	2.35	1.76	1.17	0.59		0.59	1.17	1.76	2.35
1.715	10.5	9.91	9.33	8.75	8.16	7.58	7.00	6.42	5.83	5.25	4.67	4.08	3.50	2.92	2.33	1.75	1.17	0.58		0.58	1.17	1.75
1.720	11.0	10.4	9.85	9.26	8.68	8.11	7.52	6.95	6.37	5.79	5.21	4.64	4.06	3.48	2.90	2.32	1.74	1.16	0.58		0.58	1.16
1.725	11.5	10.9	10.3	9.77	9.20	8.63	8.05	7.48	6.91	6.33	5.75	5.18	4.60	4.03	3.45	2.88	2.30	1.73	1.15	0.57		0.57
1.730	12.0	11.4	10.8	10.3	9.71	9.14	8.57	8.00	7.43	6.86	6.29	5.71	5.14	4.57	4.00	3.43	2.86	2.29	1.71	1.14	0.57	

Example: If the specific gravity of an enamel is to be changed from 1.690 to 1.670, go down the column headed by 1.690 until on a level with 1.670 on the extreme left. Where these two lines join it is seen that 2.49 pounds of water must be added for every 10

gallons of slip. If the value found is below the sloping white space on the chart it indicates that much water is to be removed instead of added, because the slip is to be made heavier.

*W. G. Martin, W. W. Higgins and G. L. Bryant, A. O. Smith Corp., Checked, 1951

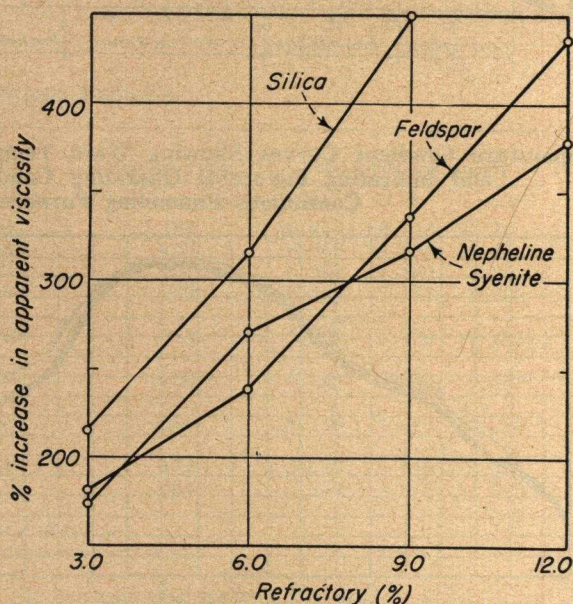
Surface Dimension and Weights of Sheets

Thickness, Weight per Square Foot and Surface Pickled for 1000, 300 and 100 Pounds of Sheets

U.S. Standard Gauge No.	Approximate Thickness in Decimal Parts of an Inch	Weight Per Square Foot in Pounds	Number of Square Feet Two Sides of Sheet Per		
			1000 Lbs.	300 Lbs.	100 Lbs.
000	.375	15.00	133.3	40.0	13.3
00	.344	13.75	145.5	43.6	14.5
0	.313	12.50	160.0	48.0	16.0
1	.281	11.25	177.8	53.3	17.8
2	.266	10.63	188.2	56.3	18.8
3	.250	10.00	200.0	60.0	20.0
4	.234	9.38	213.5	64.0	21.4
5	.219	8.75	229.0	68.6	22.9
6	.203	8.13	246.5	73.8	24.7
7	.188	7.50	267.0	80.0	26.7
8	.172	6.88	291.0	87.3	29.1
9	.156	6.25	320.0	96.5	32.0
10	.141	5.63	356.0	106.5	35.6
11	.125	5.00	400.0	120.0	40.0
12	.109	4.38	457.0	137.0	45.7
13	.094	3.75	534.0	160.0	53.4
14	.078	3.13	641.0	191.5	64.1
15	.070	2.81	712.0	213.0	71.2
16	.063	2.50	800.0	240.0	80.0
17	.056	2.25	890.0	266.0	89.0
18	.050	2.00	1000.0	300.0	100.0
19	.044	1.75	1140.0	343.0	114.0
20	.038	1.50	1330.0	400.0	133.0
21	.034	1.38	1450.0	436.0	145.0
22	.031	1.25	1600.0	480.0	160.0
23	.028	1.13	1780.0	533.0	178.0
24	.025	1.00	2000.0	600.0	200.0
25	.021	.88	2290.0	686.0	229.0
26	.019	.75	2670.0	800.0	267.0
27	.017	.69	2920.0	875.0	292.0
28	.016	.63	3200.0	960.0	320.0
29	.014	.56	3560.0	1065.0	356.0
30	.013	.50	4000.0	1200.0	400.0
31	.011	.44	4580.0	1375.0	458.0
32	.010	.41	4930.0	1470.0	493.0
33	.009	.38	5330.0	1600.0	533.0
34	.009	.34	5830.0	1740.0	583.0
35	.008	.31	6400.0	1920.0	640.0

Courtesy, American Chemical Paint Co., 1953

Increase in Molten Apparent Viscosity of Ground Coat Enamels with Increases in Refractory Mill Additions



Courtesy, JACS, February, 1949

Properties of Typical Enamel Slips

Type of Enamel	Sp. Gr.	Fineness
Sheet Iron G/C	1.55-1.75	5-10
Zr. S/I White C/C	1.80-1.90	4-7
Sb. S/I White C/C	1.80-1.90	4-7
Ti. S/I White C/C	1.65-1.80	1/2-3
Colored S/I Enamels	1.80-1.90	2-6
White Lead Bearing CI	2.20-2.40	2-6
White Leadless CI	1.80-1.90	4-8
Colored Lead Bearing CI	2.20-2.40	1-3
Colored Leadless CI	1.80-1.90	4-8

Checked 1956

Pickling Practice at Westinghouse Vitreous Enamel Plant

Stevens High-Lift Automatic Machine

Tank	Addition	Temp. ° F.	Duration	Remarks
Cleaner No. 1	10 oz. per gal. Pennsalt #45X Emulsion type cleaner	210°	3 Min.	Steel Tank
Cleaner No. 2	7 oz. per gal. Pennsalt #34 Emulsion type cleaner	210°	3 Min.	Steel Tank
Cleaner No. 3	7 oz. per gal. Pennsalt #34 Emulsion type cleaner	210°	3 Min.	Steel Tank
Hot Water Rinse	.....	90°-100°	1 Min.	.....
Cold Water Rinse	.....	.....	1 Min.	Overflowing
#1 Sulfuric Acid	4.5-5.0% H ₂ SO ₄	Automatic Control 150°	2½ Min.	Lead lined Tank
#2 Sulfuric Acid	4.5-5.0% H ₂ SO ₄	Automatic Control 150°	1½ Min.	Lead lined Tank
Cold Weak Acid Rinse	.....	.....	¼ Min.	Lead lined Tank
Nickel Sulfate Solution	1.80 oz. per gal.	Auto.-Cont. 165°-170°	5 Min.	Rubber lined tank Equipped with Ind. Filter
Cold Water Rinse	.....	.....	¼ Min.	Overflowing
Neutralizer	.80 oz. Soda—Ash/Gal. .20 oz. Borax/Gal.	130°-140°	3 Min.	Steel Tank
Neutralizer	.27 oz. Borax/Gal.	115°-120°	1½ Min.	Steel Tank; Equipped with Industrial Filter
Gas Dryer	.....	.....	3 Min.	.....

Checked 1956

Present Nickel Dip Practice in Porcelain Enamel Plants

Plant	Single or Double Salts	Nl. Salts per Gal.	Boric Acid per Gal.	Dip or Spray Pickle	Temp. of Solutions (deg. F.)	Time of Dip or Spray	Acid Rinse After Dip or Spr.	Cost of Dip or Spr. per 1000 sq. ft.
Geo. D. Roper Corp.	S	1 oz.	none	Dip	130-140	3½-4½	1/10 of 1%	20c
Westinghouse	S	1.80 oz.	none	Dip	165-170	5 mins.	no	48c

Checked 1956

Recommended Pickle Tank Operations

Tank Solutions	Approx. amount of chemical required to make up tank solution	Operating pH of Tank Solution	Operating Tank Temp.	Operating Tank Strength to be maintained	Operating tank time of immersion	Operating life of tank solution
Cleaner	6-8 oz. of any standard alkali cleaner per gallon	—	212° F. Boiling	2-4% Na ₂ O	20 minutes	60-100 sq. ft. of ware per gal. of cleaner. Discard cleaner when normal addition no longer affects Na ₂ O content of tank.
Cleaner Rinse	Running Water	—	—	—	Rinse thoroughly	—
Sulphuric Acid	Approx. 1 gal. of 66° Be sulphuric acid per 25 gallons	—	140°—160° F.	6-8% sulphuric acid by weight	10-15 minutes	50-100 sq. ft. ware per gal. of acid solution. Discard when iron sulphate content of tank reaches 13.5%.
Acid Rinse	Running Water	—	—	—	Rinse thoroughly	—
Nickel Bath —Note 1	.59 oz. Single Nickel Sulphate salts per gal.	—	150°—160° F.	No Control	5-10 minutes	8-10 sq. ft. of ware per gal. Discard after above footage passed thru tank.
Nickel Bath —Note 2	2 oz. Single Nickel Sulphate salts per gal.	pH 3-4	150°—160° F.	1.5-2.0 oz. single nickel sulphate salts per gal.	3-6 minutes	—
Nickel Rinse	Running Water	—	—	—	Rinse thoroughly	—
Neutralizer	.16 oz. Borax per gal. .48 oz. Soda Ash per gal.	—	180°—190° F.	.2-3% Na ₂ O	3-5 minutes	Discard daily.

Note 1—Bath and procedure is recommended where no chemical control is exercised and facilities are not available to reclaim the remaining salts in tank.

Note 2—Bath and procedure is recommended where chemical control is exercised and facilities are available for removing iron sludge. This nickel pickling set-up is by far the most economical and permits securing the maximum benefits from the nickel bath.

Checked 1956

Cost of Abrasive in Air Blasting of Steel

	Steel Grit	Silica Sand
A. Purchase Price of Material Per Pound		
1. Material cost	\$0.1550	\$0.0020
2. Handling—new and scrap	0.0050	0.0020
3. Total cost	0.1600	0.0040
Ratio of cost—40 to 1		
B. Consumption of Material /Sq. ft. Cleaned		
Pounds of abrasive used	.03 Lbs.	2.10 Lbs.
Ratio of use 1 to 70		
C. Cost of Abrasive/Sq.: Ft. Cleaned	0.0048	0.0084
Percentage saving	57%	100%
Saving by using steel grit 48%		

From the table it may be seen that while steel grit costs about 40 times as much as silica sand, it does 70 times the cleaning before being discarded. Moreover, the discarded grit still has some value as scrap. From paper by Raeuber and Ploetz of A. O. Smith Corporation, presented at the 11th PEI Forum.

Checked 1956

Summary of Costs in Air Blasting of Steel

Estimated Cost Per Sq. Ft. Cleaned	Steel Grit	Silica Sand
A. Material Cost	\$0.0048	\$0.0084
B. Burden Costs		
1. Maintenance labor	0.0039	0.0053
2. Maintenance materials	0.0021	0.0051
3. Compressed air ... (Theoretical)	0.0016	0.0023
C. Power for equipment .....	.....	.....
D. Direct labor .....	.....	.....
E. Equipment costs .....	.....	.....
This is a 41% saving for steel grit blast over costs for sand-blast	0.0124	\$0.0211

The table shows that both material and burden costs are far less for steel grit blasting of sheet steel than for silica sand blast. In total this indicates an approximate saving of 41 percent through the use of steel grit. Power, direct labor and equipment costs are assumed to be equal for the two methods. From a paper by Raeuber and Ploetz presented at the 11th PEI Forum.

Checked 1956

Effect of Weather on Various Porcelain Enamels

Acid resistance class ²	Average percent of initial specular gloss retained ³ at—			
	Washington	Lake-land	Atlantic City	Average at three locations
AA	73.3	81.6	69.6	74.8
A	69.7	70.0	62.3	67.3
B	70.7	64.2	50.2	61.7
C	54.9	43.1	52.8	50.3
D	44.4	36.0	46.3	42.2

¹ Each enamel represented by 2 panels at each location.

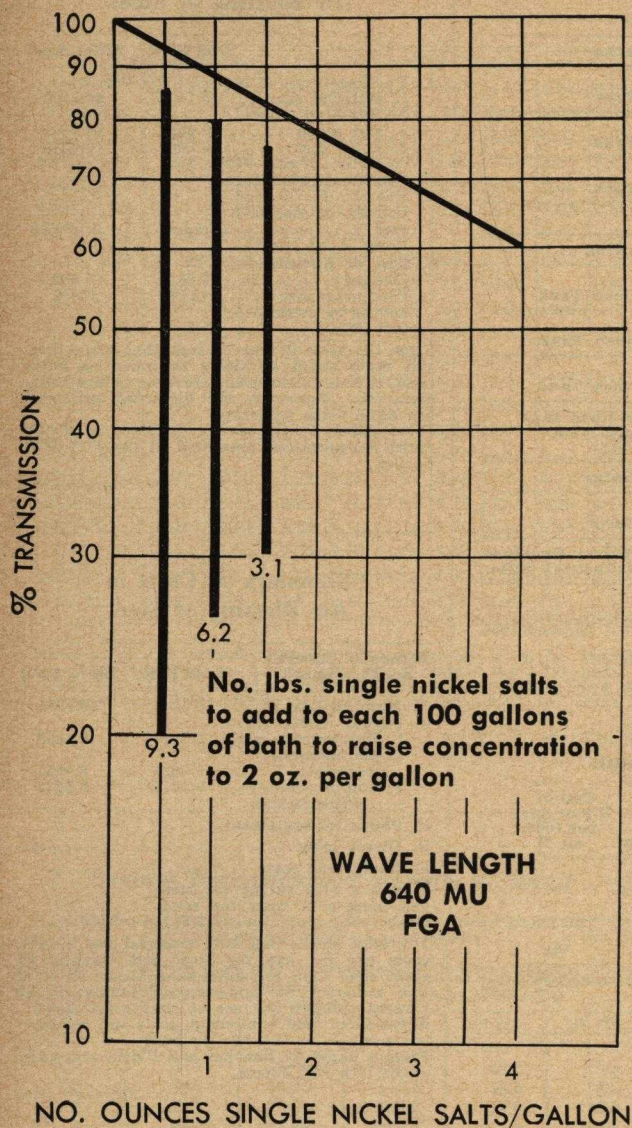
² From spot tests made on 12-in. by 12-in. storage panels, using the porcelain Enamel Institute standard acid-resistance spot test for flatware.

³ Percentage of gloss retained for St. Louis panels not included because tightly adhering surface deposits made gloss measurements unreliable.

In the commercial test, which separates enamel according to classes, a small pool of 10-percent citric acid is placed on the specimen for 15 min at 80° F. The degree of attack is then evaluated by visual methods by using such characteristics as visual strain, blurring of image, and ease of removal of a pencil mark. Class AA shows no visible effect from the treatment and is the most resistant, with class A, class B, class C, and class D following in that order. Enamels falling in the latter two classes are not considered as acid resistant.

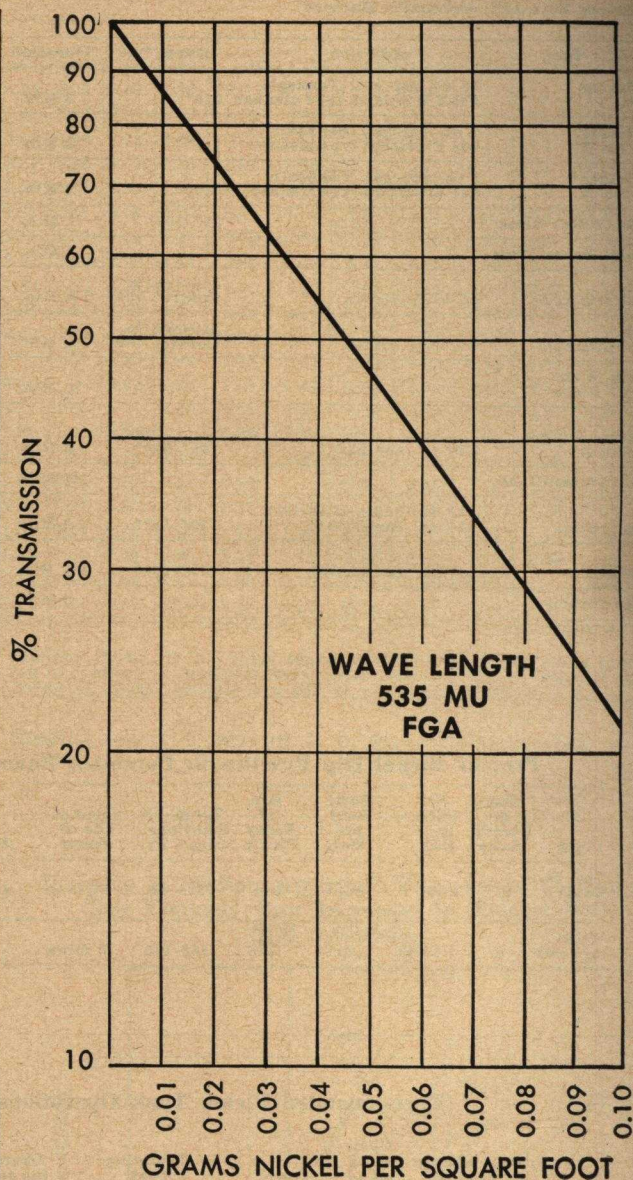
Checked 1956

Typical Nickel Concentration Curve



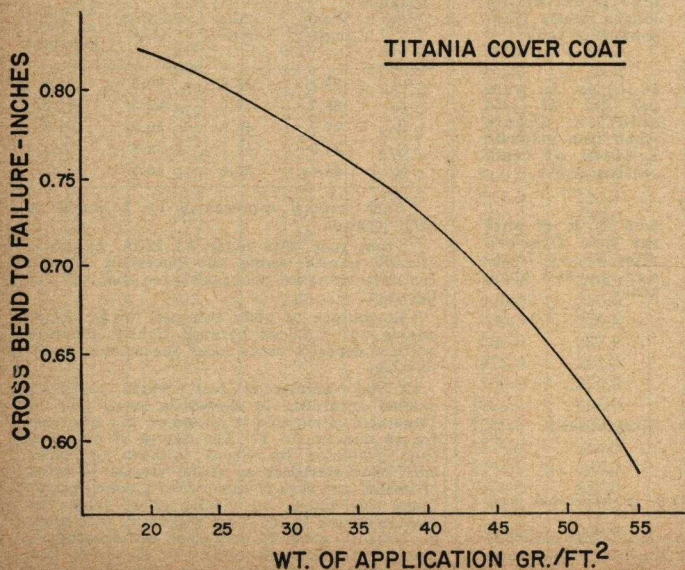
Courtesy, O. Hommel Co., 1956

Typical Nickel Deposition Curve



Courtesy, O. Hommel Co., 1956

Effect of Wt. of Application on Adherence



Checked 1956

Typical Compositions for Enameling Sheets

	Carbon	Mn	Phos.	Sulfur	Soluble Al
Rimmed Mild Steel.....	.06%	.35%	.01%	.03%	Nil
Enameling Iron	.03%	.05%	.01%	.03%	Nil

Courtesy, Inland Steel Co., 1953

One-Coat Titanium Enamel Formula

Frit	100 parts
Clay	2%
Oxide	1/16%
Bentonite	3/4%
Sodium Aluminate	1/4%
Potassium Carbonate	1/4%
Sodium Nitrite	1/16%
Gum Tragacanth	1/16%
De-Ionized Water	31%

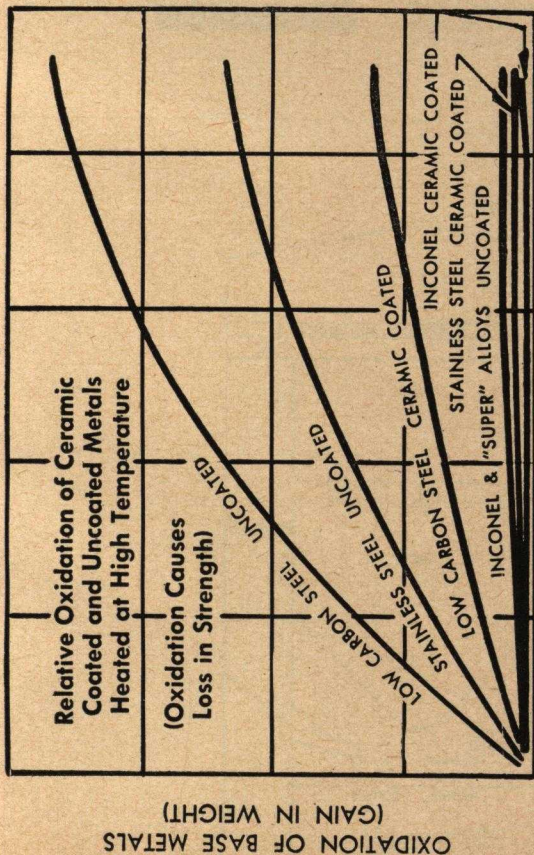
Above formula is milled to a fineness of 0-0.1% on 200 Mesh screen.

3% Urea is added on wet basis prior to using.

Enamel is milled at 1.84 Specific Gravity, and is sprayed at 1.74-1.75 Specific gravity.

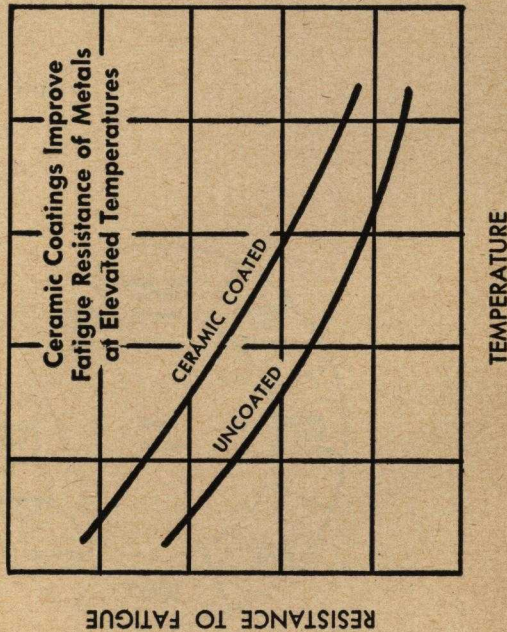
Checked 1956

Relative Oxidation of Coated and Uncoated Metals Heated at High Temperature



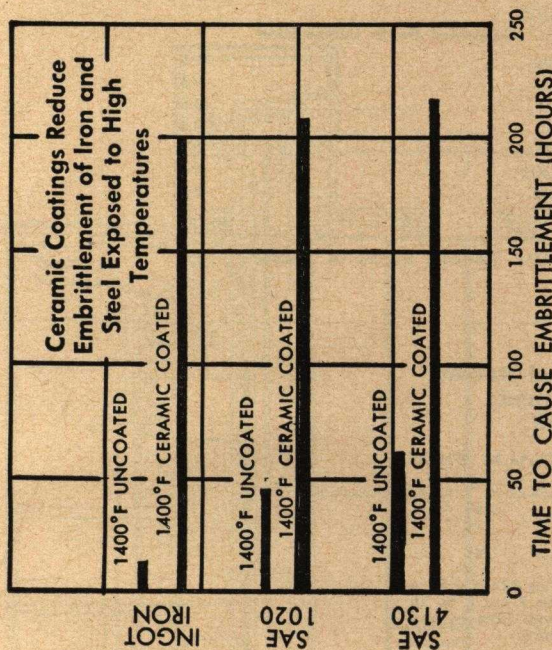
Courtesy, Pfaudler Corp., 1956

Ceramic Coatings Improve Fatigue Resistance of Metals at Elevated Temperatures



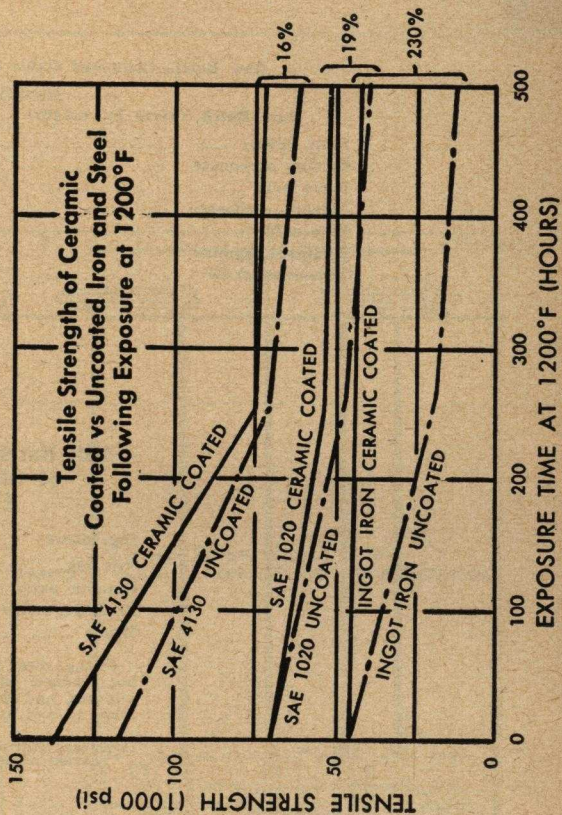
Courtesy, Pfaudler Corp., 1956

Ceramic Coatings Reduce Embrittlement of Iron and Steel Exposed to High Temperatures



Courtesy, Pfaudler Corp., 1956

Tensile Strength of Ceramic Coated Versus Uncoated Iron and Steel Following Exposure at 1200°F.



Courtesy, Pfaudler Corp., 1956

High Temperature Coating for Heat Resistant Alloys

National Bureau of Standards Ceramic Coating A-418

Frit—

Raw Batch, Computed Oxide Composition and Smelting Data for Frit 332

Raw Batch (parts by weight)		Computed Oxide Composition	
Flint (SiO ₂)	37.50	SiO ₂	37.5
Barium carbonate	56.63	B ₂ O ₃	6.5
Boric Acid	11.50	BaO	44.0
Calcium carbonate	6.25	CaO	3.5
Zinc oxide	5.00	ZnO	5.0
Hydrated alumina	1.52	Al ₂ O ₃	1.0
Zirconium oxide ¹	2.50	ZrO ₂	2.5
	120.90		100.00

Courtesy, National Bureau of Standards, 1957

**Mill Batch for National Bureau
of Standards Ceramic
Coating A-418**

Ingredient	Parts by Weight
Frit 332	70
Chromic oxide (commercial) ...	30
Enameler's clay	5
Water	48

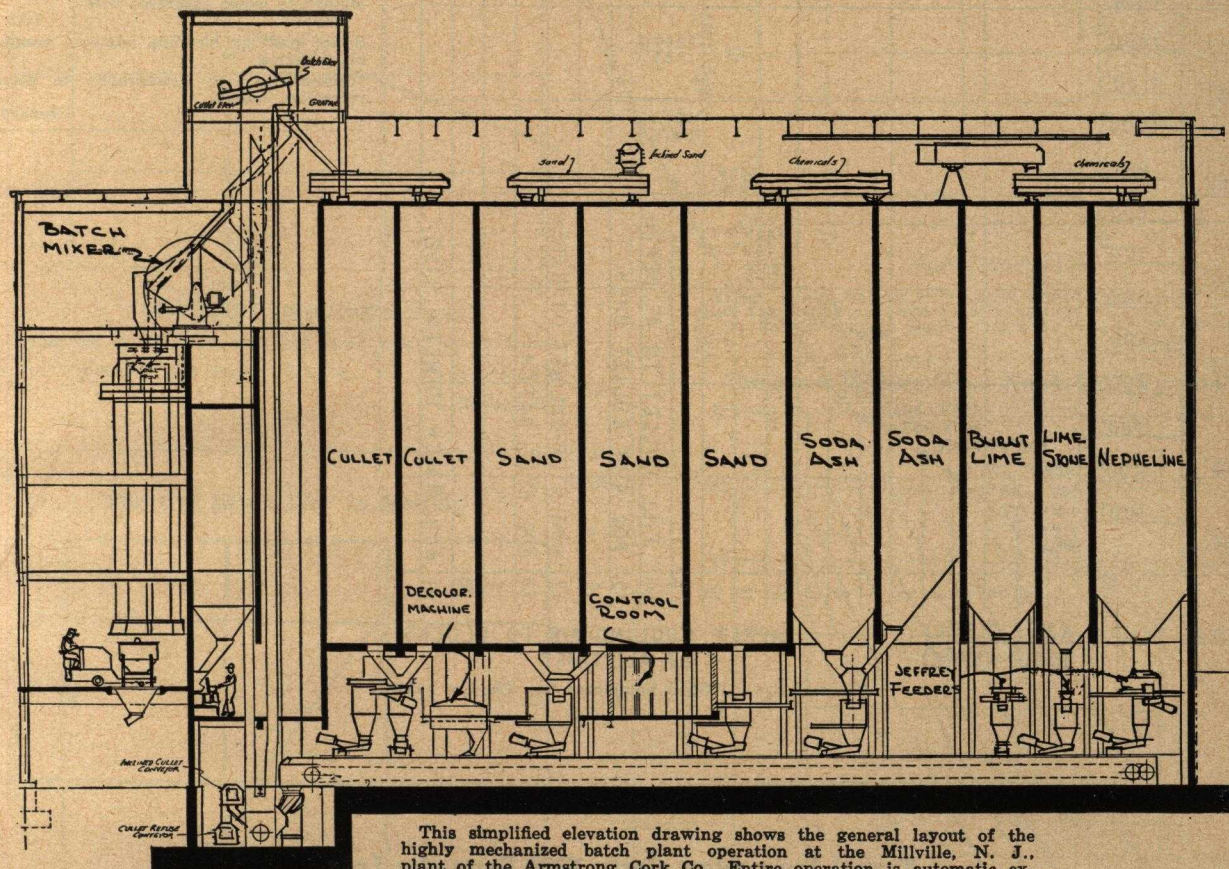
Firing—heat part to 1875°F by placing in a hot furnace, hold at 1875°F for from 3 to 10 minutes, and then withdraw from furnace and allow to cool to room temperature.

Courtesy, National Bureau of Standards, 1957

Glass Manufacture

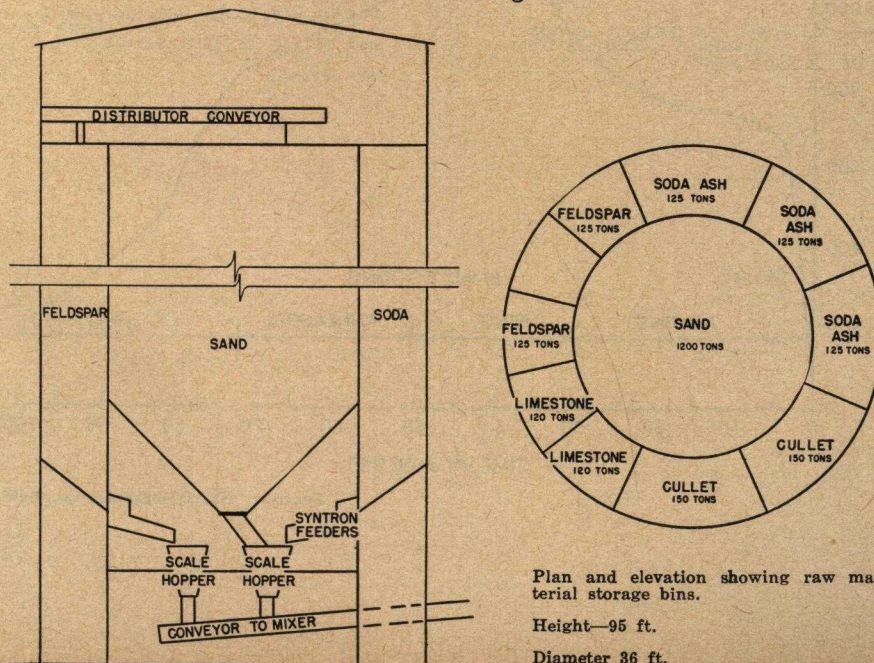
15

Batch Plant Layout



This simplified elevation drawing shows the general layout of the highly mechanized batch plant operation at the Millville, N. J., plant of the Armstrong Cork Co. Entire operation is automatic except weighing of colorants and decolorizers. Checked 1956

Raw Material Storage Bins



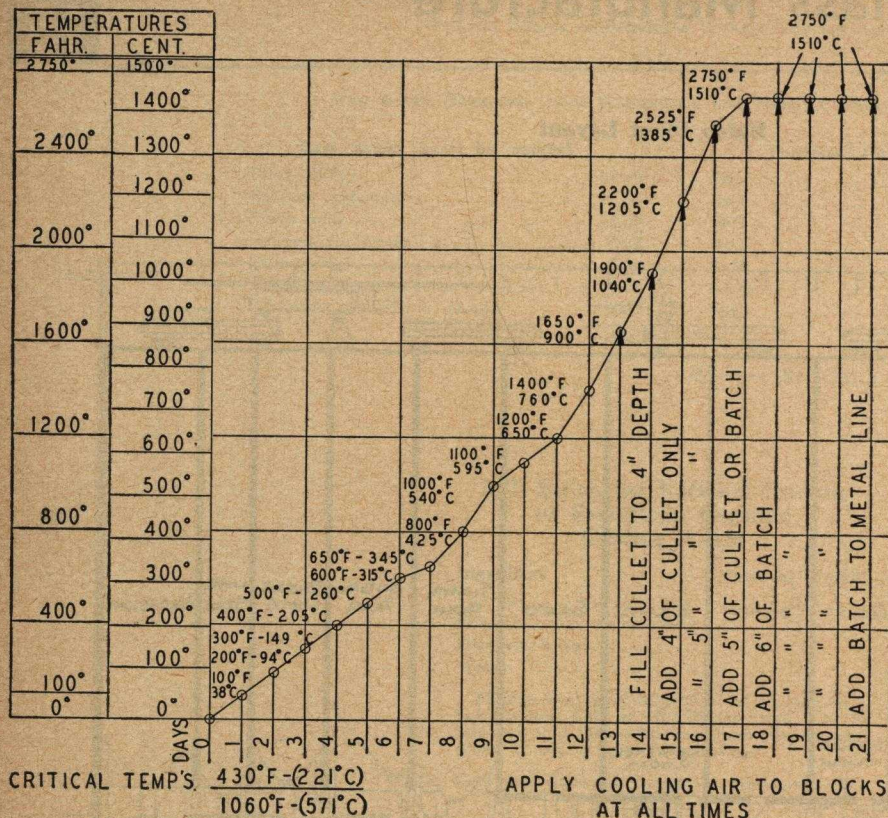
Plan and elevation showing raw material storage bins.

Height—95 ft.

Diameter 36 ft.

Courtesy Ball Bros. of California, Inc.,
Checked 1956

21 Day Furnace Heating Schedule



Courtesy General Glass Equipment Co., Checked 1956

Components for Preparation of Immersion Media*

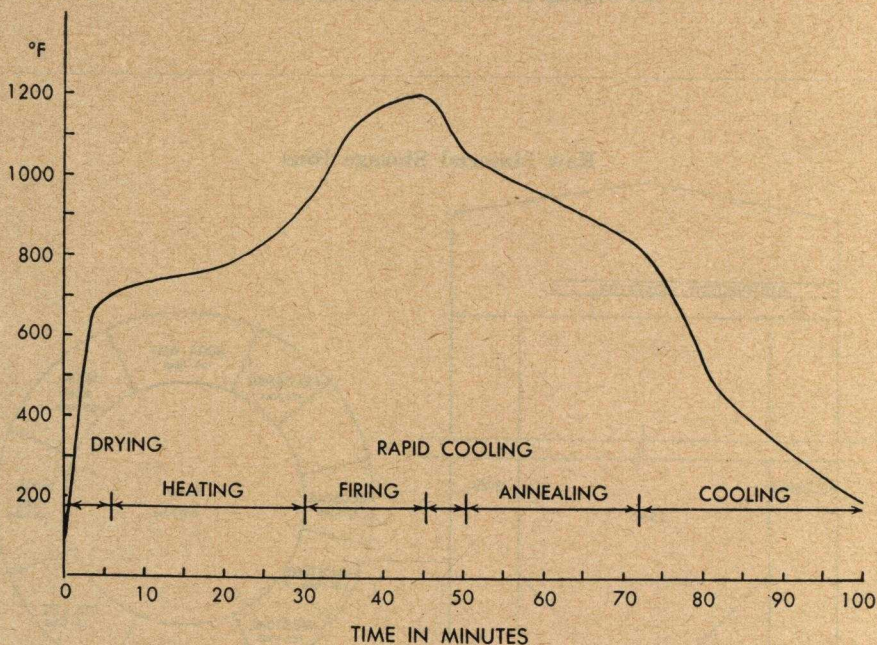
Component	Approximate No
Iso-Amyl valerate	1.41
Petroleum Oil	1.47
Alpha-monochloronaphthalene	1.63
Alpha-monobrominaphthalene	1.66
Methylene iodide	1.74
Methylene iodide saturated with sulphur	1.78

Series made by blending adjacent numbers in above series.

*Liquids used in petrography to determine refractive indices.

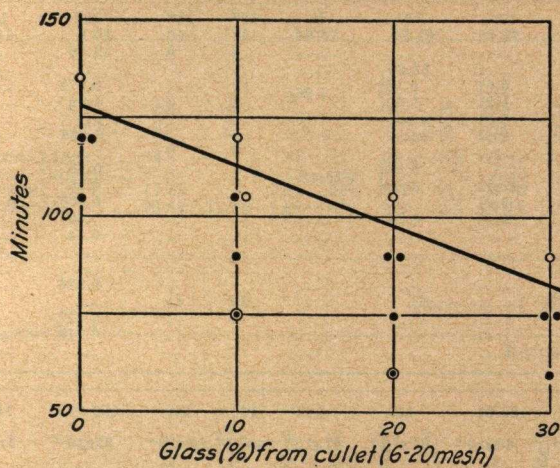
Checked 1956

Typical Temperature Curve X139 Decorating Lehr



Courtesy, Hartford-Empire Co., 1956

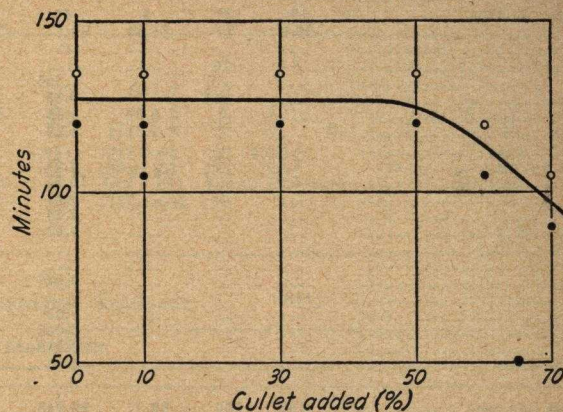
Effect of Cullet on Time



Glass No. 2, effect of cullet on time to get batch free at 2600° F.
Potts, Brookover and Burch, J.A.C.S., Vol. 27, No. 8, Aug. 1944.

Checked 1956

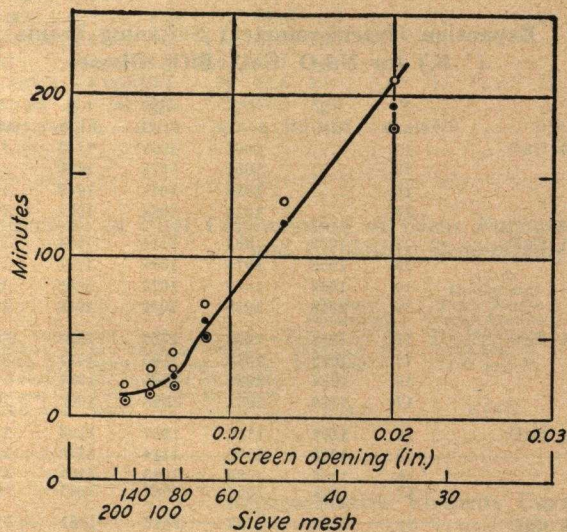
Effect of Cullet Additions



Effect of amount of 6/20 cullet added: base glass, 46/60 sand, 40/60 soda ash, and 40/60 limestone.
Potts, Brookover and Burch, J.A.C.S., Vol. 27, No. 8, Aug. 1944.

Checked 1956

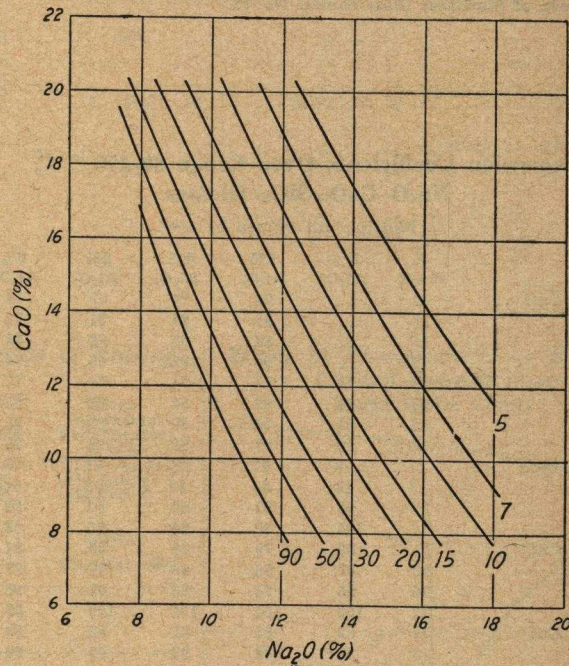
Effect of Grain Size on Melting



Effect of grain size and melting time (sand, soda-ash and limestone of same mesh size).
Potts, Brookover and Burch, J.A.C.S., Vol. 27, No. 8, Aug. 1944.

Checked 1956

Constant Melting Time Na₂O-CaO Varying



System Na₂-CaO-SiO₂; lines of constant melting time at 1427° C. (time in minutes).

Potts, J.A.C.S., Vol. 24, No. 2, Feb., 1941.
Checked 1956

Glass Compositions, Thermal Expansion Coefficients and Deformation Temperatures for the Glasses Shown													
Glass Number	1*	2*	3	4†	5	6	7	8	9	10*	11*	12†	13
SiO ₂	56.0	27	71.84	74.1	71.58	73.28	71.88	61.91	74.84	48	40	80.6	100
BaO	...	...	...	...	...	...	...	...	...	4	6	12.76	...
PbO	8.5	70	...	...	...	...	...	22.23	...	...	...	...	...
Fe ₂ O ₃	...	...	1.21	0.65	0.12	0.48	0.07	0.15	...	...	...	...	...
Al ₂ O ₃	...	...	...	0.33	0.54	...	1.21	1.00	4.36	1	...	0.076	...
CaO	...	...	6.09	4.65	12.94	5.31	5.01	trace	2.55	...	8	1.94	...
MgO	...	...	4.01	3.23	0.10	3.88	3.64	trace	1.77	...	...	0.026	...
ZnO	8.5	...	...	...	...	...	...	...	...	9	9	...	...
K ₂ O	8.0	3	...	0.04	...	...	...	6.19	...	...	...	0.16	...
Na ₂ O	5.0	...	16.62	16.65	14.00	16.31	17.59	8.32	16.48	7	...	4.16	...
SO ₃	...	...	...	0.41	...	...	0.41	...	...	1	...	0.009	...
As ₂ O ₃	...	...	...	0.03	...	...	0.20	0.20	...	...	...	0.085	...
As ₂ O ₅	...	...	...	0.07	...	...	...	...	...	...	...	0.14	...
Na ₂ SO ₄	...	...	...	...	0.66	...	...	...	...	...	...	...	...
NaCl	...	...	...	...	0.06	...	...	...	...	...	...	...	...
Cl	...	...	...	...	...	...	...	...	...	...	...	...	...
BaO	14.0	...	...	0.047	...	...	...	...	...	...	...	0.036	...
TiO ₂	...	...	...	...	...	0.24	...	...	...	30	42	...	...
ZrO ₂	...	...	...	0.02	...	...	...	...	...	...	...	0.027	...
MnO	...	...	...	0.003	...	...	...	...	...	...	...	0.013	...
Ignition Loss	...	...	...	0.30	...	...	...	...	...	...	...	...	...
Total per cent	100	100	99.77	99.948	100	99.50	100.01	100	100	100	100	100.032	100
Mean Coefficient of linear expansion (25-200°C.)	95x10 ⁻⁷	88x10 ⁻⁷	96x10 ⁻⁷	92x10 ⁻⁷	93x10 ⁻⁷	93x10 ⁻⁷	90x10 ⁻⁷	91x10 ⁻⁷	87x10 ⁻⁷	84x10 ⁻⁷	68x10 ⁻⁷	32x10 ⁻⁷	5x10 ⁻⁷
Deformation temperature, deg. C.	555	458	562	559	601	567	567	482	558	628	676	630	...

*Composition calculated from batch by Bailey & Sharp Co.

†Bureau of Standards Glass Sample No. 80.

‡Bureau of Standards Glass Sample No. 93.

Courtesy, Libbey-Owens-Ford Glass Co.
Checked 1956

Expansion Coefficients Over Range 80-170 ° C.							Expansion (Interferometer) Softening Points						
Na ₂ O-CaO . SiO ₂ Glasses							(° F.) for Na ₂ O . CaO . SiO ₂ Glasses						
Multiply all values by 10 ⁻⁷													
	% Na ₂ O	0% Al ₂ O ₃	2% Al ₂ O ₃	4% Al ₂ O ₃	6% Al ₂ O ₃	8% Al ₂ O ₃		% Na ₂ O	0% Al ₂ O ₃	2% Al ₂ O ₃	4% Al ₂ O ₃	6% Al ₂ O ₃	8% Al ₂ O ₃
6% CaO	11	..	74	74	75	76	6% CaO	11	..	1067	1099	1132	1164
	13	..	81	81	81	82		13	..	1054	1076	1098	1117
	15	..	88	88	88	88		15	..	1038	1054	1069	1085
	17	..	96	99	95	94		17	..	1022	1038	1054	1072
8% CaO	11	76	74	74	74	77	8% CaO	11	1072	1094	1114	1134	1166
	13	84	82	82	82	82		13	1058	1076	1094	1112	1125
	15	91	90	89	89	90		15	1042	1058	1072	1089	1092
	17	99	97	96	96	96		17	1026	1038	1049	1063	1076
10% CaO	11	78	77	76	77	79	10% CaO	11	1090	1105	1126	1150	1168
	13	85	84	83	83	84		13	1072	1087	1105	1121	1130
	15	93	91	90	90	92		15	1054	1069	1081	1094	1099
	17	100	99	99	96	98		17	1036	1051	1058	1065	1081
12% CaO	11	80	79	79	80	81	12% CaO	11	1107	1116	1137	1164	1170
	13	87	86	86	87	87		13	1085	1098	1114	1132	1137
	15	95	94	93	94	93		15	1065	1080	1080	1101	1108
	17	102	101	101	100	99		17	1045	1063	1069	1067	1085
14% CaO	11	82	81	82	83	83	14% CaO	11	1116	1132	1148	1161	1171
	13	88	88	90	90	89		13	1096	1110	1125	1134	1144
	15	96	97	97	96	95		15	1074	1087	1101	1112	1117
	17	103	103	104	103	102		17	1054	1067	1078	1085	1094
16% CaO	11	83	...	...	...	...	16% CaO	11	1126	...	...	...	...
	13	90	...	...	...	...		13	1105	...	...	...	...
	15	97	...	...	...	...		15	1083	...	...	...	...
	17	105	...	...	...	...		17	1062	...	...	...	...

Silverman, J.S.G.T. 24, p. 59 (1940)

Checked 1956

Silverman, J.S.G.T. 24, p. 59 (1940)
Checked 1956

Factors for Coefficient of Expansion		Ratio of Expansion Coefficients		Range of Physical Values Obtainable from Various Glasses	
Na ₂ O-CaO-SiO ₂ Glasses		of Selected Materials			
Oxide	Factor per 1% Oxide per 10 ⁻⁷ °C.			Property	Range of Values
Li ₂ O	8.56 × 10 ⁻⁷	Fused quartz (0.54 x 10 ⁶)	1	Refractive Index	1.467—2.179
Na ₂ O	8.86 × 10 ⁻⁷	Carbon	2	Specific Gravity	2.125—8.120
K ₂ O	3.20 × 10 ⁻⁷	Pyrex glass	6	Elasticity coefficient	6,500,000—12,500,000 lb. per sq in.
CaO	1.36 × 10 ⁻⁷	Porcelain	6	Compressive strength	90,000—180,000 lb. per sq in.
CaO-MgO	1.10 × 10 ⁻⁷	Tungsten	9	Tensile strength	4,000—1,000,000 lb. per sq in.
BaO	1.03 × 10 ⁻⁷	Hard glass	10	Thermal conductivity	0.0018—0.0023 cal. per cm. per deg. C. per sec.
MgO	0.73 × 10 ⁻⁷	Tantalum	11	Expansion coefficient	8x10 ⁻⁷ —140x10 ⁻⁷ cm. per cm. per deg. C.
SiO ₂	0.23 × 10 ⁻⁷	Flint Glass	14	Softening point	500°C.—1510°C.
Al ₂ O ₃	0.24 × 10 ⁻⁷	Graphite	14	Annealing point	350°C.—890°C.
B ₂ O ₃	0.60 × 10 ⁻⁷	Plate & crown glass	16	Volume resistivity	10 ⁸ —10 ¹³ ohms per cc.
ZnO	1.23 × 10 ⁻⁷	Platinum	17	Dielectric constant	3.7—16.5

*Added since original reference.

Above data all based on original data—Owens-Illinois Glass Co., General Research Lab.

Illustration—1% Na₂O for 1% SiO₂
Na₂O + 1.0 × 3.86 = + 3.86 × 10⁻⁷
SiO₂ - 1.0 × 0.23 = - .23 × 10⁻⁷
Change + 3.63 × 10⁻⁷

Ghering & Knight, J.A.C.S. 27, 260 (1944)

Checked 1956

C. J. Phillips, Glass, The Miracle Maker, Pitman Pub. Co.

Bureau of Standards Averaged Analyses

	SiO ₂	B ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	ZrO ₂	Na ₂ O	MgO	K ₂ O	P ₂ O ₅	SO ₂	Cl	As ₂ O ₃	As ₂ O ₅	CaO	F	PbO	ZnO	MnO	BaO	Ign. loss
Soda-Lime	74.1	..	.33	.07	.02	.003	16.65	3.23	.04	..	.41	.047	.03	.07	4.65	..	..	..	.003	..	.30
Lead-Barium	65.4	..	.18	.049	.01	..	5.70	.03	8.40	.23	.03	.05	.03	.36	.21	..	17.50	..	.09	..	.32
Opal	67.53	..	6.01	.081	.019	.01	8.48	.008	3.25	.022	..	.014	.091	.102	10.48	..	..	..	..	..	..
Boron	80.60	12.76	1.94	.076	.027	.013	4.16	.026	.16	?	.009	.036	.085	.14	?	5.72	..	..	..	..	..

Checked 1956

Bureau of Standards Averaged Analyses

	SiO ₂	FeO ₂	Al ₂ O ₃	TiO ₂	MnO	CaO	SrO	MgO	Na ₂ O	K ₂ O	SO ₂	S	P ₂ O ₅	CO ₂	C	H ₂	CaF ₂	Zn	Pb	BaO	CrO ₂	ZrO ₂	FeO	Ign. loss
Limestone	14.11	1.63	4.16	.16	.038	41.32	.12	2.19	.39	.71	.04	.25	.15	33.33	.61	..	..	..	..	..	..	..	..	34.55
Dolomite	.31	.084	.067	.005	.006	30.49	<.01	21.48	.08	.03	.035	.013	.003	47.25	.08	.008	..	..	..	..	..	..	..	47.52
Silica brick	93.94	.66	1.96	.16	.005	2.29	..	.21	.06	.29	..	..	.025	..	..	..	..	..	..	..	..	..	..	.38
Burned magnesite	2.54	7.06	.84	.03	.43	3.35	..	85.67	.04	<.01	..	..	.057	..	..	..	..	..	..	..	..	..	..	..
Potash spar ...	66.66	.03	18.03	.002	..	.07	..	.013	2.38	12.58	..	..	..	..	..	..	..	..	..	..	..	..	..	.22
Soda spar	68.66	.067	19.06	.017	..	.36	..	.053	10.73	.41	..	..	..	..	..	..	..	..	..	..	..	..	..	.52
Fluorspar	1.88	.15	.02	.003	.003	..	..	.13	.06	.01	..	.13	.005	.99	..	..	94.83	.35	.23	.07	..	..	..	..
Chrome refractory	8.24	..	20.83	.93	..	.79	..	16.27	..	..	..	..	..	..	..	..	..	..	..	..	36.97	..	14.39	..
Bauxite } 4 val.	6.3	5.66	55.06	3.07	.55	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.08	..	28.77
and } 4 val.	54.7	2.4	37.7	2.2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.07	..	..	.22
Alumina } 4 val.	32.4	.90	59.4	2.9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.09	..	..	.21
Refrac. } 4 val.	20.7	.79	70.0	3.4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.12	..	..	.26
Glass sand	..	.073	.265	.095	..	.029	..	.016	..	..	..	..	..	..	..	..	..	..	..	..	.031	..	..	..

Reduction in Fuel Consumption of Glass Furnace as a Result of Sealing and Insulating Regenerators

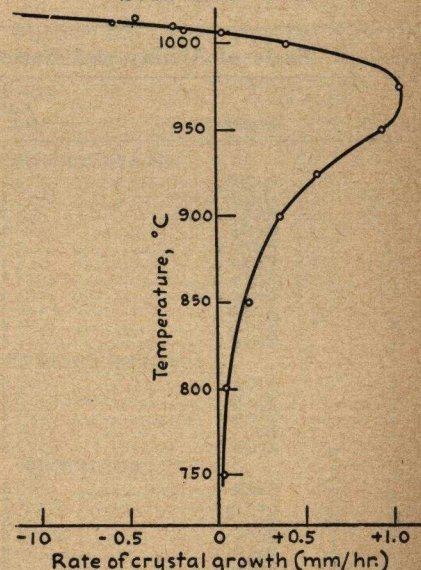
	Before Insulation	After Insulating Port Necks and Arches	After Sealing Regenerator Walls	After Insulating Regenerator Walls
Fuel consumpt.	762,000 Cf/day	756,000 Cf/day	737,000 Cf/day	701,000 Cf./day
Preheat of air, back of ports. . .	1914 deg. F.	1922 deg. F.	1931 deg. F.	1935 deg. F.
Waste gas temp. in reg. canal. . .	1210 deg. F.	1250 deg. F.	1280 deg. F.	1235 deg. F.
Increase in O ₂ content of waste gases between back of ports and reg. canal	2.74%	2.00%	0.72%	0.25%

Checked 1956

Representative Viscosity Curves

	Ther- mometer Glass	Lead Boro- silicate	Con- tainer	Con- tainer	High Soft. Point Tubing	Labor- atory Boro- silicate	Vycor	Vitreous Silica
SiO ₂	67.3	75.0	71.0	71.7	58.7	81.0	96.0	100.0
Fe ₂ O ₃	2.5	...	.9	1.5	22.5	2.0	...	...
CaO	7.0	...	10.7	7.3	5.9	...	...	...
MgO	...	...	.6	4.8	8.4	...	...	...
BaO	...	...	.6	.4	...	...	...	...
K ₂ O	...	...	.3	.3	.2	...	...	...
Na ₂ O	14.0	5.0	14.9	14.1	1.1	4.0	...	...
B ₂ O ₃	2.0	15.0	.5	...	3.0	13.0	4.0	...
ZnO	7.0	...	...	...	...	...	...	...
PbO	...	5.0	...	...	...	...	...	...
Logarithm Viscosity — *F:								
15.0	...	...	962	937	...	...	...	...
14.6	...	...	973	950	...	950	1454	1958
14.0	...	...	991	968	...	...	...	...
13.4	...	...	1011	991	...	1027	1634	2084
12.0	...	...	1060	1047	1063	...	...	...
10.0	...	...	1153	1150	...	...	...	...
8.0	...	...	1285	1296	...	...	...	...
7.65	1285	1390	1312	1323	...	1506	2750	3002
7.0	1340	1465	1373	1393	...	...	...	...
6.0	1450	1600	1485	1517	...	1742	...	...
5.0	1585	1790	1630	1675	1989	1953	...	...
4.0	1775	2045	1823	1888	2118	2239	...	...
3.0	2045	2420	2109	2187	2345	2653	...	...
2.5	...	...	...	...	2566	...	...	...
2.0	2470	3025	2543	2644	...	3804	...	...
	3	3	4	4	1	2-3	2	2

Effect of Temperature on Rate of Crystal Growth in a Soda-Lime Glass



H. R. Swift, JACS, Vol. 30, No. 6, June, 1947
Checked 1956

Alkali Extracted as NaOH

Temp. C	95	75	50	Room
Time	7 hr.	2 days	3 weeks	Temp.
Bottle	Alkali extracted	as NaOH	(mg./liter)	1 year
B	7	6	7	7
D	9	9	9	9
E	10	11	9	9
G	11	11	11	11
C	14	12	12	13
A	16	16	14	11
J	15	16	15	15
H	15	17	16	17
K	15	20	18	17
F	19	21	17	16
I	21	24	22	21

Data reported by Bacon and Burch.
Checked 1956

The Complete Viscosity Curve

A Typical Glass Viscosity Curve, °F.	Item	Log Viscosity	Comparative Physical Dimensions** (in centimeters)
	Viscosity Water	-2	Hair's Breadth
		-1	Thickness Pasteboard
		0	1 cm. = 2 5/8 inch
2660	Glycerine	1	Hand's Breadth
2190	Melting	2	Height of Chair Back
1884	Begin Working	3	Street Width
1668	Range	4	Skyscraper
1506	End Working	5	Kilometer
1384	Range	6	Distant Landscape
1317	Fiber Soft. Point.	7	
	Glass Tubing Colapses in Air	7.65	
1285		8	
1204		9	
1137		10	
1081	Tubing Collapses in Vacuum	11	Earth's Diameter
1070	Interferometer Soft. Pt.	11.3	Moon's Distance
....	Approx. Warping Temp.-Optical Flats	11.75	
1035		12	
....	Approx. Transformation Temp.	13	
993	Annealing is Almost Instantaneous	13	Sun's Distance
979	Annealing Point	13.4	
955		14	
936	Strain Point	14.6	
925		15	
		18	Near Stars

**McKay, The Photographic Negative. (Prepared by H. H. Holscher)

One of the most important properties, if not the most important one, of glass from the viewpoint of manufacture and the forming of glass articles is its viscosity. In the last generation of scientific application, viscosity problems and their relationships to the manufacturing processes have been widely studied. A tendency to interpret high temperature processes as related to viscosity has grown up, thus making the present-day common interpretation of viscosity vs. temperature curves an important phase of glass technology. Scientific processes are carried out in relation to specific viscosity values. Melting occurs at approximately 100 poises (100 poises is equal to log viscosity = 2), with some variation. See GLASS GLOSSARY, definition of "Melting Temperature." The "softening point" refers to both a definitely set procedure and apparatus for its determination and conforms to a definite viscosity value (log viscosity = 7.6, or 40,000,000 poises). Similarly, the "annealing point" refers also to a definite procedure and viscosity value (log viscosity = 13.4, or 25,000,000,000 poises). On the basis of plotting of viscosity in poises along the ordinate vs. temperature on the abscissa (rather than by logarithm of viscosity), we obtained a chart with dimensions extending to those indicated on the right-hand column of the table. This gives some idea of the great change of viscosity with temperature. See the GLASS GLOSSARY for more specific definitions, in the Bulletin of The American Ceramic Society, Vol. 27 (9) 353-362 (1948).

Checked 1956

Scale of Acidity and Basicity in Glass

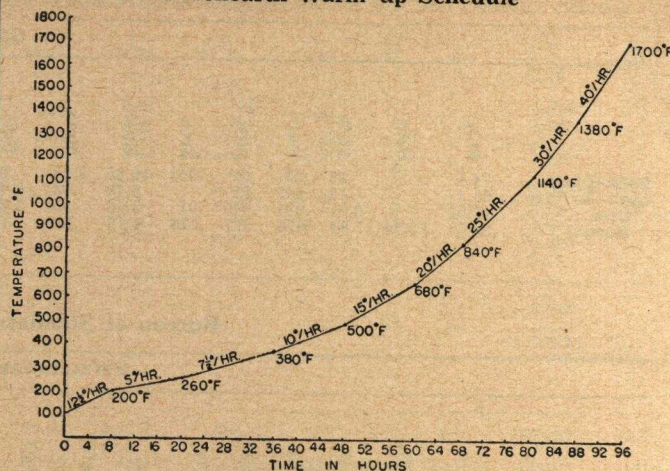
MmO _n	Coordination Adopted No. of M	The Arbitrary Scale (M.O Bond Strength)
GLASSFORMERS		
B ₂ O ₃	3	119
B ₂ O ₃ *	3, 4	113
SiO ₂	4	106
GeO ₂	4	108
P ₂ O ₅	4	88-111
V ₂ O ₅	4	90-112
Al ₂ O ₃	4	79-101
B ₂ O ₃	4	89
As ₂ O ₅	4	70-87
Sb ₂ O ₅	4	68-85
ZrO ₂	6	81
INTERMEDIATES		
TiO ₂	6	73
Al ₂ O ₃	6	53-67
ThO ₂	8	64
BeO	4	63
ZrO ₃	8	61
MODIFIERS		
Sc ₂ O ₃	6	60
La ₂ O ₃	7	53
Y ₂ O ₃	8	50
SnO ₂	6	46
Ga ₂ O ₃	6	45
In ₂ O ₃	6	43
ThO ₂	12	43
PbO	6	39
MgO	6	37
Li ₂ O	4	36
PbO	4	36
ZnO	4	36
CaO	8	32
SrO	8	32
BaO	8	33
CdO	4	30
Na ₂ O	6	20
CaO	6	20
K ₂ O	6	20
Rb ₂ O	9	13
HgO	10	12
Cs ₂ O	12	10

*In ordinary commercial borosilicate in which there are abundant of oxygen for all boron to change to coordination of 4. Unpublished investigation by the author, however, reveals that only about 20 percent of the total boron atoms take 4-fold coordination, the rest remain in a coordination number of 3.

Developed by Kuan-Han Sun.

Checked 1956

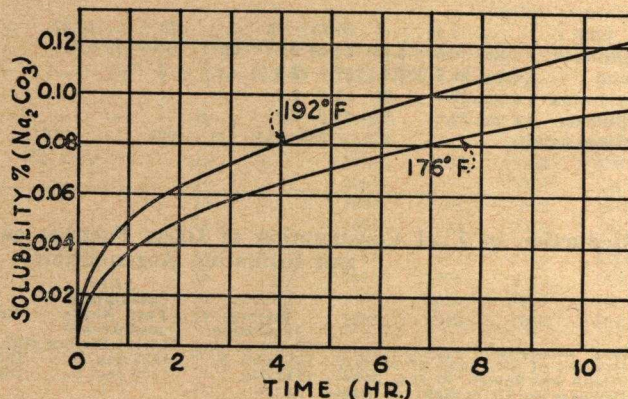
Forehearth Warm-up Schedule



Refractory damage is minimized when this four-day warm-up schedule is used for glass tank forehearths.

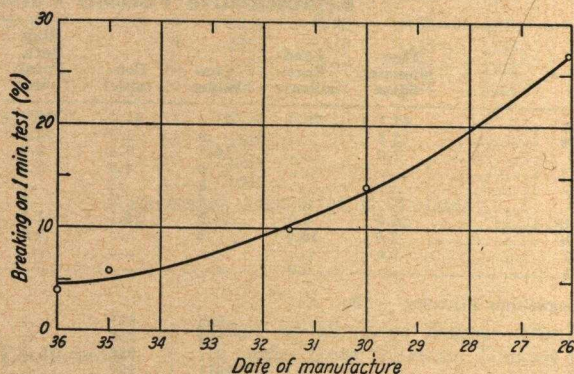
Checked 1956

Effect of Time of Autoclave Test on Solubility of Soda-Lime Glasses



Checked 1956

Age Deterioration of Bottles



Example of deterioration of bottle strength with age and abuse; used Coca Colas tested at 400 lb. per sq. in.

Checked 1956

Theoretical Annealing Curves for Soda-Lime Glasses

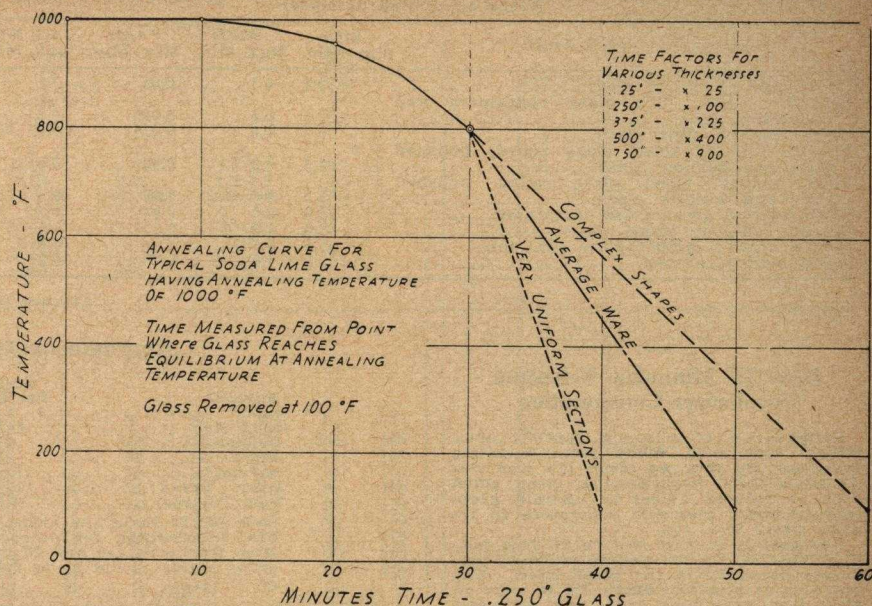
While the curve is made up for a theoretical annealing temperature of 1,000° F., the shape of the curve and the elapsed time for any temperature drop will be approximately the same for higher and lower annealing temperatures.

The theoretical cooling curves shown below 800° F. for three different types of ware will, in actual operation, tend to flatten out at the lower temperatures, requiring a longer total time to reach a temperature of 100° F., especially for the shorter time cycles.

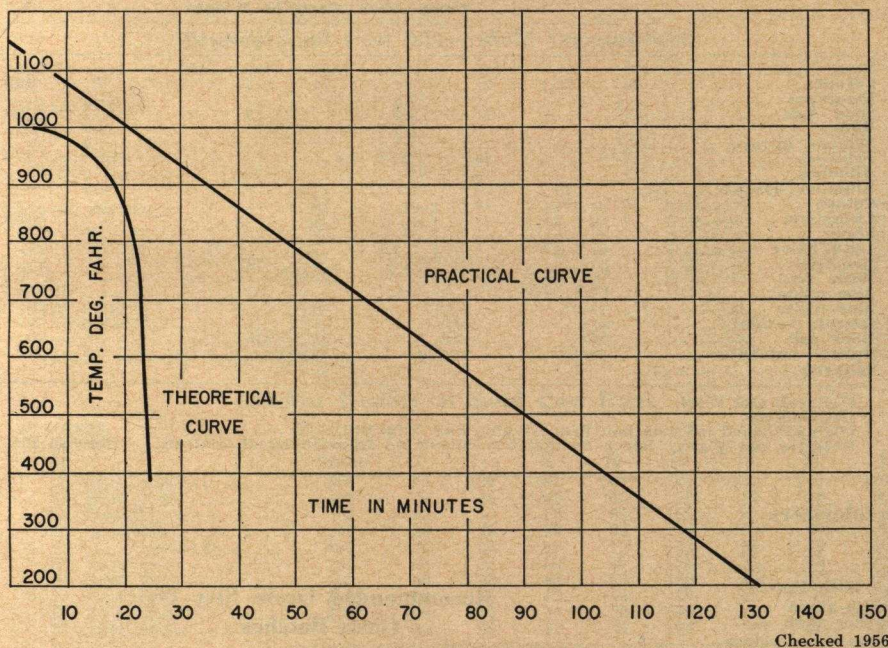
The amount of residual strain present in the glass when it leaves thelehr is determined entirely by the shape of the cooling curve in the first 150 to 200° of cooling below the theoretical annealing temperature. The indicated curve, used with correction factors for thicknesses to be annealed, will give first-grade commercial annealing on all normal glasses.

In attempting to apply this curve on existing lehrs, it follows that the indicated time-temperature cycle for the first 200° temperature drop from the annealing temperature should be closely followed. It is, of course, necessary to establish a uniform temperature throughout the mass of the glass before annealing can begin, and the time required for this must be added to the time shown by the curve.

Courtesy, Surface Combustion Corp.
Checked 1956



Time—Temperature Curve for Annealing Glass



Checked 1956

Surface Tension—Composition Effects

	(Additive per 1% Composition)	
	Dynes per Cm. At 1200°C	At 1400°C
Al ₂ O ₃	5.98	5.85
MgO	5.77	5.49
CaO	4.92	4.92
BaO	(3.7)	(3.8)
SiO ₂	3.25	3.24
Na ₂ O	1.27	1.12
B ₂ O ₃	0.23	—0.23
K ₂ O	(0.00)	(—0.753)

(Lyon, J.A.C.S. 27, 186, 1944)
Checked 1956

Factors for Calculating the Thermal Expansion of Glasses and Enamels

Composition	Thermal expansion (cubical)		
	M. & H. $\times 10^{-7}$	W. & S. $\times 10^{-7}$	E. & T. $\times 10^{-7}$
SiO ₂	0.8	0.8	0.15
Al ₂ O ₃	5.0	5.0	0.42
B ₂ O ₃	0.1	0.1	—1.98
Na ₂ O	10.0	10.0	12.96
K ₂ O	8.5	8.5	11.7
PbO	4.2	3.0	3.18
ZnO	2.1	1.8	2.1
CaO	5.0	5.0	4.89
MgO	0.1	0.1	1.35
BaO	3.0	3.0	4.2
As ₂ O ₃	2.0	2.0	
P ₂ O ₅	2.0	2.0	
Sb ₂ O ₃	3.6		
SnO ₂	2.0		
TiO ₂	4.1		
ZrO ₂	2.1		
Na ₃ AlF ₆	7.4		
NaF	7.4		
AlF ₃	4.4		
CaF ₂	2.5		
Cr ₂ O ₃	5.1		
CoO	4.4		
CuO	2.2		
Fe ₂ O ₃	4.0		
NiO	4.0		
MnO ₂	2.2		

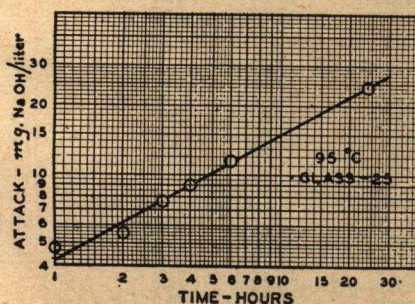
E. & T.—Corrected to English and Turner, J. Am. Ceram. Soc. 12, 760 (1929).
W. & S.—Winkelmann and Schott, Jena Glass.
M. & H.—Mayer and Havas.
Checked 1956

Effect of Viscosity on Rate of Crystal Growth

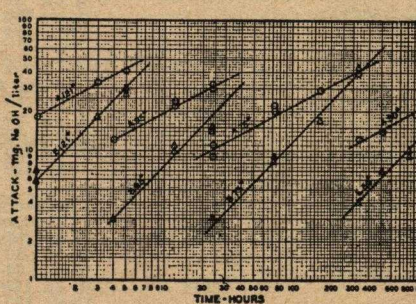
Log Viscosity	Poise	Rate of Crystal Growth in Microns per Minute
4.86	72500	Approx. 5
4.27	18600	Approx. 6–10
3.92	8300	Approx. 13
3.80	6300	Approx. 24
3.73	5400	Approx. 32
3.57	3700	Approx. 55

Adapted from Littleton, Jour. Soc. Glass Technology, Vol 15, p. 286 (1931)
Checked 1956

Chemical Attack of Glasses by Water



Time-attack results for single lot of 6 oz. capacity bottles tested at 95° C.



Time-attack results for two lots of bottles tested at 50°, 75°, 95°, and 121° C., after Bacon and Burch.

Courtesy, A. K. Lyle, J.A.C.S., Vol. 26, No. 6, June, 1948.
Checked 1956

Percentage Composition of Sands of Various Qualities

(Based on Ignited Samples)

	SiO ₂		Al ₂ O ₃		Fe ₂ O ₃		CaO, MgO	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
First quality, optical glass.....	99.8	0.1			0.02		0.1	
Second quality, flint glass containers and tableware.....	98.5	0.5			0.035		0.2	
Third quality, flint glass.....	95.0	4.0			0.035		0.5	
Fourth quality, sheet glass rolled, polished plate and window glass.....	98.5	0.5			0.06		0.5	
Fifth quality, sheet glass rolled, polished plate and window glass.....	95.0	4.0			0.06		0.5	
Sixth quality, green glass containers.....	98.0	0.5			0.3		0.5	
Seventh quality, green glass.....	95.0	4.0			0.3		0.5	
Eighth quality, amber glass containers.....	98.0	0.5			1.0		0.5	
Ninth quality, amber.....	95.0	4.0			1.0		0.5	

Checked 1956

Effect of Varying Cullet on Soda Ash Consumption

% Cullet in melted glass	Lbs. soda ash needed/100 tons	Lbs. soda ash saved/100 tons
0	54,000	none
10	48,600	5,400
20	43,200	10,800
30	37,800	16,200
40	32,400	21,600
50	27,000	27,000
75	13,500	40,500
100	none	54,000

Note: Base figure of 540 lbs. soda ash per ton of melted glass was used in these calculations.

Ceramic Industry, July, 1951.

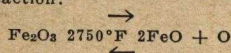
Checked 1956

How to Minimize Selenium Decolorizer Consumption

Conservation of selenium depends quite largely upon good, sound plant operating practices. By this, we mean low iron raw materials, good housekeeping, clean cullet with no reduced amber or emerald green contamination, magnetic separators to remove tramp iron, etc.

Our goal is to first remove all iron possible, then set up the weakly oxidizing conditions necessary in the batch itself. The following is a sort of check list to start on after first examining both raw materials and materials handling system:

- (1) Establish optimum arsenic level, normally 0.04 to 0.07% of total batch weight.
- (2) Establish optimum nitre level, normally approximately three times as much by weight as arsenic.
- (3) Establish uniform cullet level.
- (4) Operate furnace at lowest possible temperature. As is well known, the ferric iron tends to dissociate along the usual time-temperature cycle according to the following reaction:



- (5) Furnace combustion atmosphere must be uniform and only just mildly oxidizing. Flue gas analyses should show not more than 1 per cent excess oxygen at the port directly adjacent to dog house and charger.
- (6) Refining agents should be reexamined for possibly too high levels. Excess refining agents tend to destroy selenium. Salt cake, if used, should be replaced by either barytes or gypsum, preferably gypsum.
- (7) If at all possible, small amounts fluor-spar should be used.

- (8) Use lowest amounts of cobalt possible. If these points are followed, ten glass plants should, industry-wide, reduce their selenium consumption from an estimated 0.90 oz. selenium per ton glass batch to around 0.60 oz. selenium per ton of batch or even lower.

Manring, Ceramic Industry, 1951.

Checked 1956

Approximate Costs of Basic Oxides

Material	Cost Per Ton	Oxide	Cost of 1% Oxide in 1 Ton of Glass*
Sand	\$ 3.50	SiO ₂	\$0.035
Soda Ash	26.00	Na ₂ O	.45
Dolomite	4.00	CaO-MgO	.08
Calcite	4.00	CaO	.07
Barytes	15.00	BaO	.23
Dehy. Borax	100.00	B ₂ O ₃	1.25**
Soda Feldspar	15.00	Al ₂ O ₃	.38**

*Or for 20 lbs. of the oxide.

**After crediting for other oxides at their value (for instance, Na₂O from soda ash and SiO₂ from sand).

For a glass, build up as follows:

SiO ₂	73	×	.035	=	\$ 2.56
Al ₂ O ₃	1	×	.38	=	.38
CaO	11	×	.07	=	.77
Na ₂ O	15	×	.45	=	6.75

Total per ton of glass \$10.46

Prepared by H. H. Holscher, Revised 1951. Checked 1956

Cryolite Batches for Fluorine Opal Glasses

	Composition, Parts by Weight								
	1 ⁽¹⁾	2 ⁽¹⁾	3 ⁽¹⁾	4 ⁽¹⁾	5 ⁽²⁾	6 ⁽²⁾	7 ⁽²⁾	8 ⁽³⁾	9 ⁽⁴⁾
Sand	100	100	100	100	100	100	100	100	100
Cryolite	14	16.4	12	11	15	7	16.7	9	10.9
Fluorspar			11	15				2.5	
Soda Ash	9		11	12		25	20	26.5	29.6
Borax				30				12.2	
Sodium nitrate				3				1.0	
Feldspar			20	35				51	19.3
Alumina				0.5					
Alumina hydrate									
Potash	10	17	20		16			1.2	
Limestone	10								13.2
Lime									
Lead oxide		8.7		3.5			4		
Red lead						10			
Boric acid		3.2							2.0
Zinc oxide				11					4.9
Zinc white					6				
Arsenic (oxide)					1	1			
Bone ash						15			
Barium sulphate								2.0	
Saltpeter							4		

(1) Kreidl and Weyl.

(2) Commons.

(3) Unpublished information, Pennsylvania Salt Mfg. Co.

(4) Bates and Black. Batch composition calculated from chemical analysis.

Checked 1956

The Effect of Various Chemical Decolorizers

TABLE I

Auxiliary material A.	Without NaNO ₂	B. With NaNO ₂
None	Dark greenish-blue	Bluish-green
As ₂ O ₃	Yellow-green	Lighter than A.
Sb ₂ O ₃	Emerald green	Light straw yellow
Ce(OH) ₃	Emerald green	Light straw yellow
Sugar	Copper blue	Light straw yellow (not made)

Checked 1956

Recommended Grain Size for Glass Batches

Sand	Accepted Avg. of 10 Glass Sands
% on 16 mesh	None
% on 30 mesh	0-20
% on 60 mesh	40-80
% on 120 mesh	15-50
Thru 120 mesh	0-10

Soda Ash	Accepted Typical Test Sample
% on 16 mesh	None
% on 30 mesh	10-20
% on 60 mesh	20-60
% on 120 mesh	30-50
Thru 120 mesh	5-20

Limestone and Dolomite	Accepted Typical Test Sample
% on 16 mesh	None
% on 30 mesh	15-80
% on 60 mesh	15-50
% on 120 mesh	0-15
Thru 120 mesh	0-20

Gelstsharp, Ceramic Industry, November, 1932.

Checked 1956

The Effect of Oxidizing Conditions on Color

TABLE II

Agents	Atmosphere Oxidizing	Reducing
None	Blue green	Greenish-blue (copper blue)
NaNO ₂ + Ba (NO ₃) ₂	Green	Blue green
NaNO ₂ + Ba(NO ₃) ₂ + Ce(OH) ₃	Light straw yellow	straw yellow
NaNO ₂ + Ba(NO ₃) ₂ + Ce(OH) ₃ + MnO ₂	neutral color	amber streaks
NaNO ₂ + Ba(NO ₃) ₂ + Ce(OH) ₃ + Nd ₂ (CO ₃) ₃	neutral	
	very dichroic	greenish-blue

Checked 1956

Typical Chill Cast Glass Mold Compositions

High Carbon Type A			Low Carbon Type B		
Total carbon	3.50		Total carbon	3.10	
Si	2.30		Si	2.75	
Tensile strength	21,000		Tensile strength	28,000	
Brinell	160		Brinell	190	

Alloy Cast Iron Types						
Type	1	2	3	4	5	6
TC	3.50	3.50	3.50	3.50	3.6-3.8	3.6-3.8
Si	2.50	2.30	2.00	2.00	1.4-1.6	1.4-1.6
Ni	0-15	.60	1.00-1.25	1.00-1.25	1.20-1.50	1.20-1.50
Gr	.30	.30	.30	.30	.30	.30
Mo	None	None	None	None	None	None
Annealed	Yes	Yes	Yes	Yes	Yes	Yes
*Tensile strength	22,000	24,000	28,000	26,000	32,000	35,000
*Brinell	170	180	200	180	190	210

*Before annealing. Test bar values.
 **Vanadium .10% may be substituted.

Grading Quality of Chill Cast Irons

Physical Property No.	Maximum Grade Value	A	B	1	2	3	4	5	6
I Machinability	200	160	120	140	160	120	180	200	140
II Fine Grain	109	70	60	70	80	80	80	90	100
III Density	100	70	60	80	80	80	80	90	100
IV Graphitic	100	70	50	70	60	70	80	90	100
V No Checking	100	60	40	50	50	60	70	90	100
VI Heat Res.	50	40	30	30	35	35	40	50	50
VII Low Exp.	100	50	60	70	80	80	70	90	100
VIII Hi-Cond.	100	60	70	70	80	80	70	80	100
IX Low Growth	100	50	40	60	70	80	70	80	100
X Low Wear	50	25	30	30	40	50	30	35	45
***Total	1,000	675	560	670	735	735	770	905	935

*Before annealing. Test bar values.
 **Vanadium .10% may be substituted.
 ***Highest number represents the best grade.

Vanick, Ceramic Industry, August, 1938
 Checked 1956

Typical Sand Cast Glass Mold Compositions

C			D			E		
Total carbon	2.75		3.20			3.60		
Si	2.00		2.10			2.30		
Mn	0.60		0.50			0.50		
*Tensile strength	50,000		33,000			20,000		
Brinell	250		190			160		

10			11			12			13			14		
Total carbon	3.70	3.10-3.40	3.10-3.40	3.10-3.40	3.00-3.20	2.70-2.90	2.70-2.90	2.70-2.90	2.70-2.90	2.70-2.90	2.70-2.90	2.70-2.90	2.70-2.90	2.70-2.90
Si	2.25	1.30-1.50	1.80-2.30	1.80-2.30	1.00-1.20	1.50-1.80	1.50-1.80	1.50-1.80	1.50-1.80	1.50-1.80	1.50-1.80	1.50-1.80	1.50-1.80	1.50-1.80
Mn	0.58	0.50-0.60	0.50-0.60	0.50-0.60	0.50-0.70	0.70-0.90	0.70-0.90	0.70-0.90	0.70-0.90	0.70-0.90	0.70-0.90	0.70-0.90	0.70-0.90	0.70-0.90
Ni	1.85	1.25-1.50	0-0.50	0-0.50	1.40-1.60	1.50-2.00	1.50-2.00	1.50-2.00	1.50-2.00	1.50-2.00	1.50-2.00	1.50-2.00	1.50-2.00	1.50-2.00
*Cr	None	0.30-0.60	0.20-0.30	0.20-0.30	0.20-0.30	None	None	None	None	None	None	None	None	None
*Mo	.....	.....	0.40-0.60	0.40-0.60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cast	Chill	Chill	Chill	Chill	Chill	Chill	Chill	Chill	Chill	Chill	Chill	Chill	Chill	Chill
Anneal 1650° F.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
*Brinell	174-184	220	210	210	220	220-240	220-240	220-240	220-240	220-240	220-240	220-240	220-240	220-240
*Tensile strength	24,000	38,000	35,000	35,000	40,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000

Grading Quality of Sand Cast Irons

Physical Property No.	Maximum Grade Value	C	D	E	10	11	12	13	14
I Machinability	200	80	120	180	200	140	120	140	120
II Fine Grain	100	70	50	40	60	70	60	70	90
III Density	100	90	70	50	60	90	80	90	100
IV Graphitic	100	50	70	60	90	70	60	80	60
V No Checking	100	40	60	40	90	70	60	80	50
VI Heat Res.	50	40	30	20	25	35	35	35	35
VII Low Exp.	100	60	50	40	60	60	60	80	80
VIII Hi-Cond.	100	60	50	40	40	70	60	80	60
IX Low Growth	100	60	50	40	50	60	60	80	70
X Low Wear	50	30	25	20	25	30	30	30	35
***Total	1,000	580	575	530	700	695	625	765	700

*Before annealing. Test bar values.
 **Vanadium .10% may be substituted.
 ***Highest number represents the best grade.

Vanick, Ceramic Industry, August, 1938
 Checked 1956

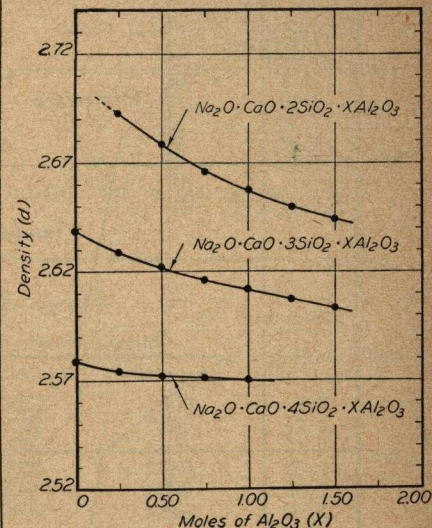
Misc. Viscosity Reference Points

	log n
Refining Temperature (English)	2.0
Flow Point (Lillie)	5.0
Softening Point (Littleton)	7.6
Annealing Point (Lillie)	13.0
Strain Point (Lillie)	14.5

Working range is the temperature interval between log n 7.6 and log 3.6

Checked 1956

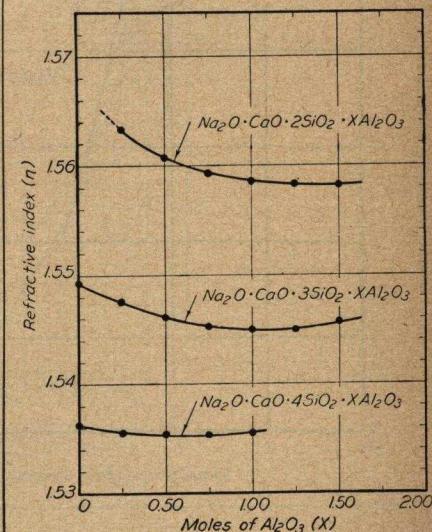
Effect on Density of Adding Alumina to Soda-Lime-Silica Glasses



Safford & Silverman, JACS, Vol. 30, No. 7, July, 1947

Checked 1956

Effect of Refractive Index of Adding Alumina to Soda-Lime-Silica Glasses



Safford & Silverman, JACS, Vol. 30, No. 7, July, 1947

Checked 1956

Factors for Calculation of Density Difference Gm/cc per 1% Composition Change

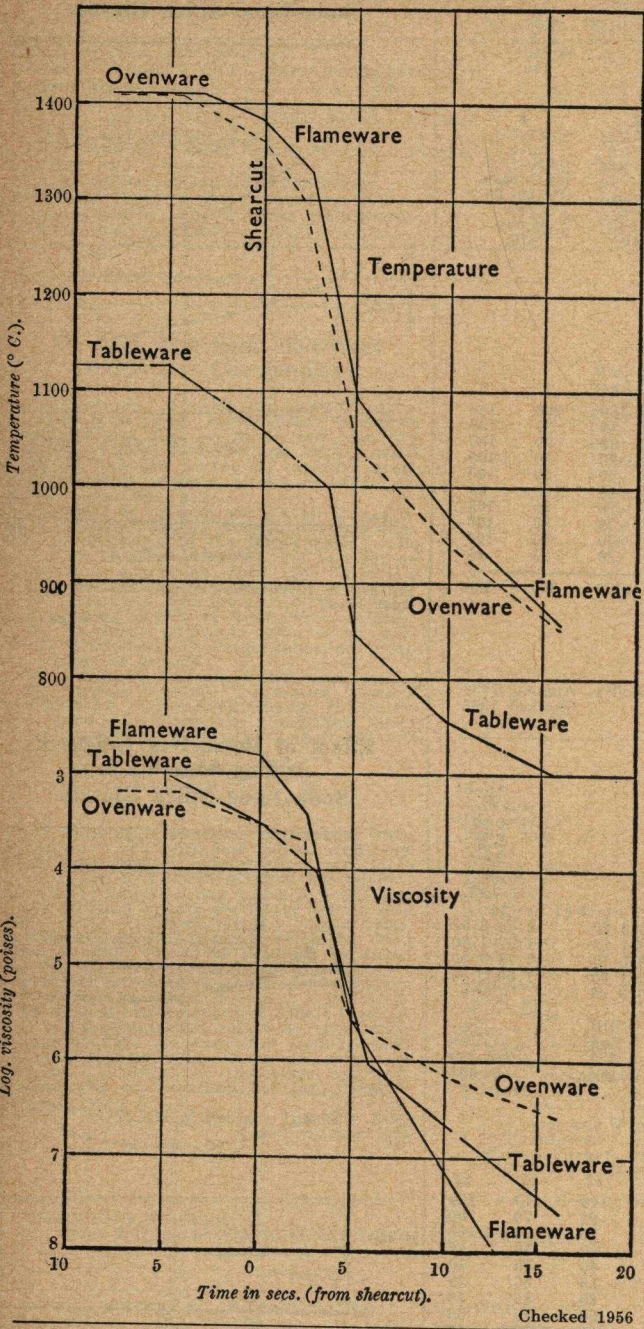
GLASS			
	Factor		Factor
B ₂ O ₃	-0.0036	CaO	+0.0106
SiO ₂	-0.0024	ZnO	+0.0145
Al ₂ O ₃	+0.0018	BaO	+0.0173
K ₂ O	+0.0028	PbO	+0.0192
MgO	+0.0050		
Na ₂ O	+0.0050		

Ref. Elliott, JACS 28(11) 303(1945)

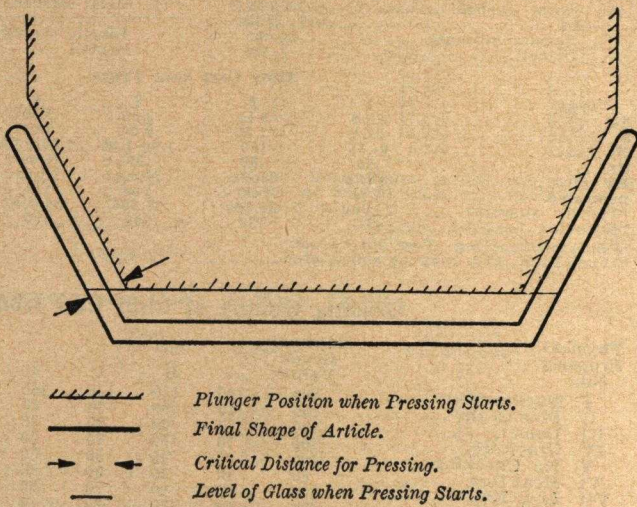
Illustration +1% increase in Na₂O, 1% decrease in SiO₂+1(+0.0050)-1(-0.0024)=+.0074.

Checked 1956

Temperature and Viscosity Changes During the Pressing of a One-Pint Bottle

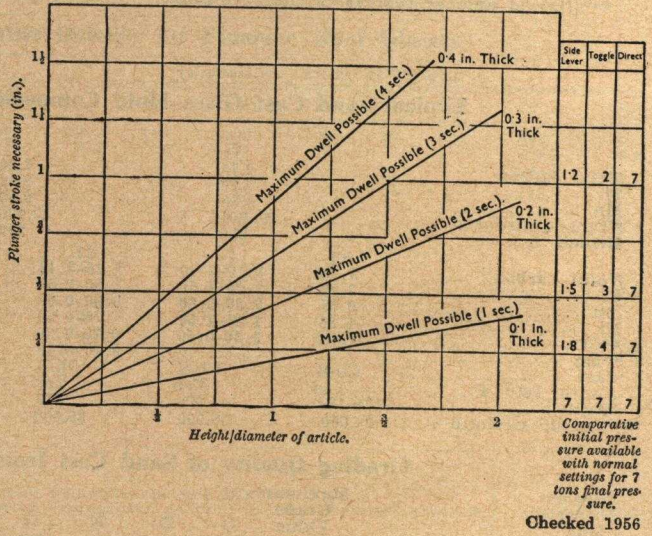


Changes in Shape of Glass During the Pressing of an Article



Checked 1956

The Influence of the Proportions of an Article (Height/Diameter Ratio) on The Pressure Necessary to Press a Flat-bottomed Cylinder



Temperature-Viscosity Values of the Glass at Successive Stages of an Automatic Blowing Machine

State in Machine Cycle	Temperature °C	Viscosity Log n
Gob formation	1009-1133 (av. 107.)	3.35-4.05 (av. 3.67)
Leaving parison mould (exterior)	920-975 (av. 950)	4.26-4.76 (av. 4.50)
Leaving parison mould (interior)	1035-1050 (av. 1044)	3.80-3.89 (av. 3.84)
Entry to blow mould (exterior)	860-900 (av. 874)	4.95-5.37 (av. 5.20)
Entry to blow mould (interior)	930-990 (av. 963)	4.19-4.67 (av. 4.39)
Discharge from blow mould	700-830	5.60-800

Laboratory Versus Commercial Measurements

Glass	Coloring agents	Analysis (%)					Gradient	
		FeO	Fe ₂ O ₃	Total Fe as Fe ₂ O ₃	Cr ₂ O ₃	MnO	Laboratory	Commercial
Flint	Se-Co-As	N.d.		0.035			10.3	7.6
Light chrome green	Chromite	0.013	0.057	0.072	0.016		18.7	11.0
Amber	Pyrites-sea coal	0.15	0.01	0.18			50	21.6
Light green	Iron-manganese	0.23	0.65	0.90		0.92	66	23.0
Chrome emerald	Chromite-sulfur	0.12	0.09	0.22	0.14		71	25.2
Dark green	Iron-manganese	0.63	1.6	2.3		0.97	98	30.8

Holscher, Rough, and Plummer, J.A.C.S., Vol. 26, No. 12, Dec. 1943.
Checked 1956

Temperature Data (° F.) for Commercial Tank Gradients*

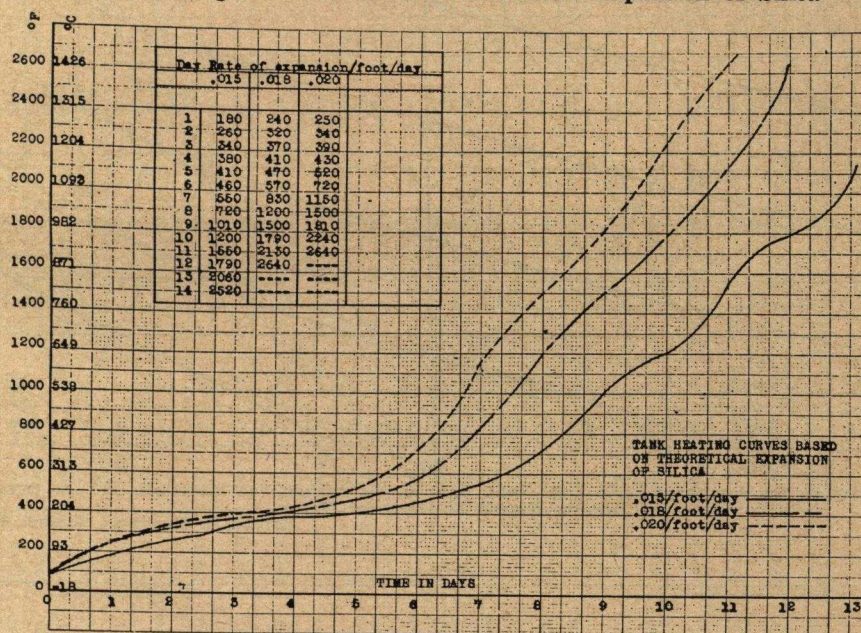
Glass	Crown couple	Optical bridge wall	Thermocouple reading (depth)			Gradient (°F./in.)
			In flame	1½ in.	26½ in.	
Flint	2710	2670	2860	2655	2465	7.6
Light chrome green	2800	2730	2885	2630	2355	11.0
Pyrites amber	2740	2700	2810	2655	2115	21.6
Light iron-manganese green	2715		2795	2625	2050	23.0
Chrome emerald green	2790	2760	2880	2650†	2020	25.2
Dark iron-manganese green	2740	2690	2775	2500	1730	30.8

* Melter depth: All 42 in. except iron-manganese greens (both light and dark) which were 36 in. deep.

† Actual reading, 2675°F., obviously in error (see Fig. 9 where this value appears best from curve).

Holscher, Rough, and Plummer, J.A.C.S., Vol. 26, No. 12, Dec. 1943.
Checked 1956

Tank Heating Curves Based on Theoretical Expansion of Silica



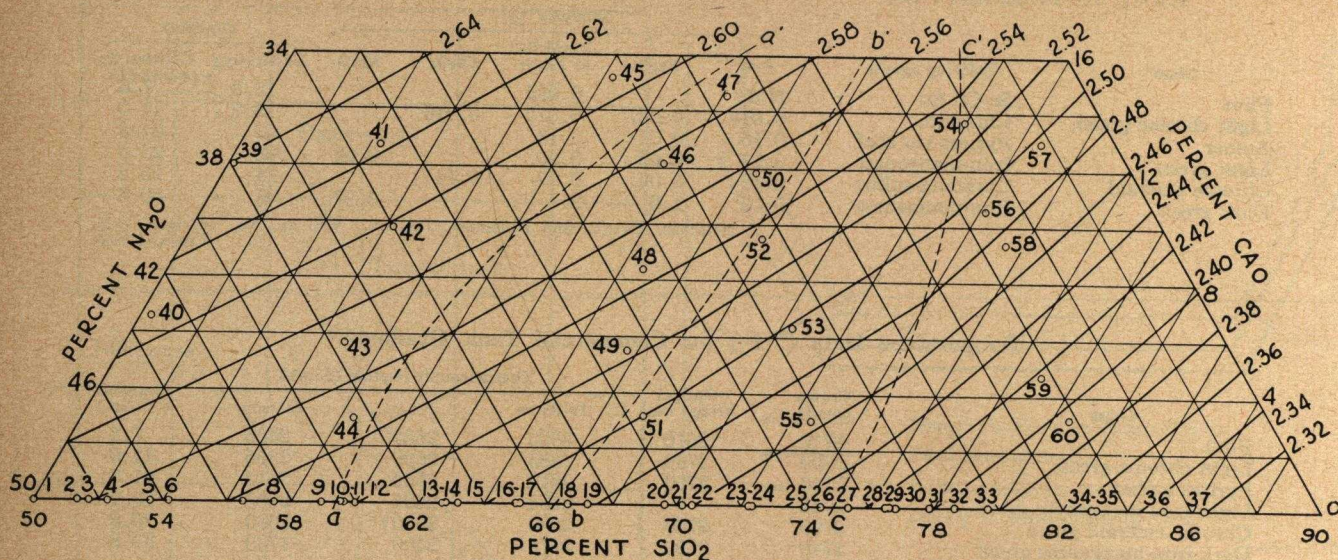
Courtesy, Corhart Refractories Co.
Checked 1956

Physical and Chemical Characteristics of the Glasses Tested

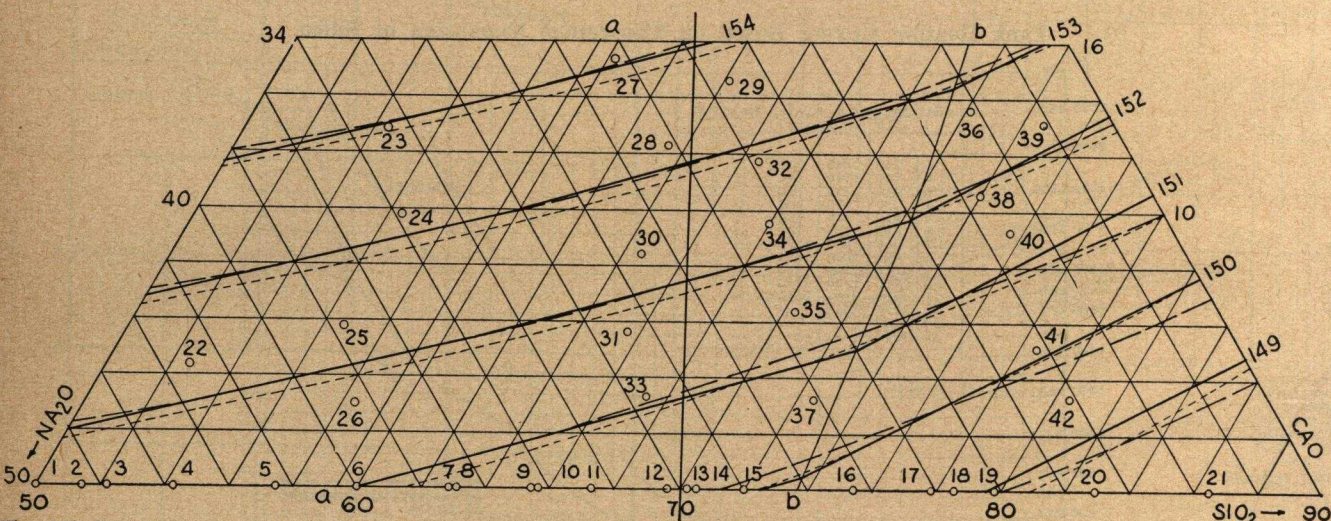
Percentage Composition	Table-ware	Oven-ware	Flame-ware
SiO ₂	72	81	58
CaO	7	—	7
Na ₂ O	16	4	1
B ₂ O ₃	—	13	6
Al ₂ O ₃	2	2	18
BaO	2	—	—
MgO	—	—	9
Specific gravity	2.45	2.24	2.46
Maximum on thermal expansion curve, ° C (i.e., 13.0 temperature)	500	555	712
Littleton softening point, ° C. (i.e., 7.8 temperature)	700	820	915
Linear thermal expansion coefficient (0°—300° C.)	9.0 × 10 ⁻⁶	3.2 × 10 ⁻⁶	4.2 × 10 ⁻⁶
Specific heat (0°—700° C.)	0.27	0.27	0.25
Thermal conductivity in c.g.s. units (at 20° C.)	0.0023	0.0025	0.0022
Thermal diffusivity in c.g.s. units (at 700° C.)	0.02	0.02	—

Checked 1956

The Relation Between Composition and Density of Some Soda-Lime-Silica Glasses

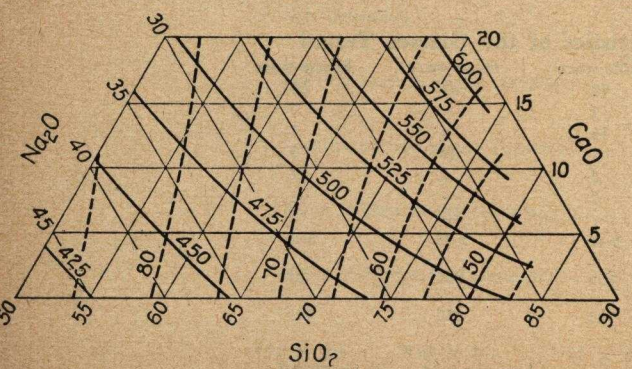


Relation Between Composition and Index of Refraction of Some Soda-Lime-Silica Glasses



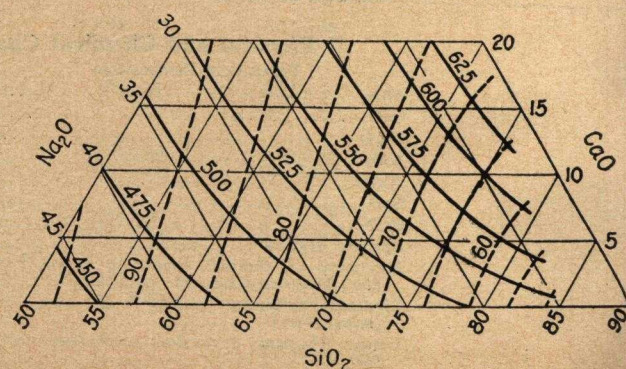
The dash lines were computed on the continuous curve basis, solid lines on the straight line hypothesis, and the dotted lines were reproduced from the diagram by Morey and Merwin
Bureau of Standards, Ceramic Industry, February, 1932.
Checked 1956

Relation Between Composition of Some Soda-Lime-Silica Glasses and Critical Temperatures



The broken lines are linear expansions to the temperatures.
Schmid, Finn and Young, Bureau of Standards Journal of Research
Checked 1956

Relation Between Composition and Softening Temperatures of Soda-Lime-Silica Glasses



Temperatures are given in degrees C. and expansions in microns per centimeter,
Checked 1956

Properties of Various Glasses

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Glass Code	Type	Color	Principal Use	Forms Usually Available	Thermal Expansion Coeff. $\times 10^{-6}/^{\circ}\text{C}$	UPPER WORKING TEMPERATURES (Mechanical Considerations Only)	Thermal Shock Res. $^{\circ}\text{C}$	Thermal Stress Resistance $^{\circ}\text{C}$	Viscosity Data	Impact Abrasion Resistance	Density (Sp. Gr.)	Modulus of Elasticity 10^{11} lb./sq. in.	Log of Volume Resistivity	Dielectric Properties at 1 Mc and 20°C	Refractive Index
						Normal Service Limit $^{\circ}\text{C}$	Normal Service Limit $^{\circ}\text{C}$		Annealing Point $^{\circ}\text{C}$	Softening Point $^{\circ}\text{C}$			250°C	Power Factor	at 1 Mc and 20°C
0010	Potash Soda Lead	Clear	Lamp Tubing	T	91×10^{-7}	110 380	—	19	397 428 626	970	2.85	9.0×10^4	17.4	0.16	1.539
0041	Potash Soda Lead	Clear	Thermometers	T	84×10^{-7}	110 400	—	19	426 460 648	—	2.89	—	—	—	1.545
0080	Soda Lime	Clear	Lamp Bulbs	BMT	92×10^{-7}	110 460	220 250	17	478 510 696	1000	2.47	9.8×10^4	12.4	0.16	1.512
0120	Potash Soda Lead	Clear	Lamp Tubing	TM	89×10^{-7}	110 380	—	17	400 433 630	975	3.05	—	17.4	0.16	1.560
1710	Hard Line	Clear	Cooking Utensils	BP	42×10^{-7}	200 650	400 450	29	672 712 915	1200	2.0	12.7×10^4	11.4	0.37	1.534
1770	Soda Lime	Clear	General	BP	82×10^{-7}	110 450	220 250	40	470 503 710	—	2.40	—	—	—	1.496
2405	Hard Red	Red	General	BPU	43×10^{-7}	200 480	—	36	506 537 802	—	2.50	—	—	—	1.508
2475	Soft Red	Red	Neon Signs	T	91×10^{-7}	110 440	—	17	466 501 693	—	2.56	—	—	—	1.511
3321	Hard Green Sealing	Green	Sealing	T	40×10^{-7}	200 470	—	39	497 535 780	—	2.27	—	—	—	—
4407	Soft Green	Green	Signal Ware	BPU	90×10^{-7}	110 460	—	17	485 518 695	—	2.53	—	—	—	1.525
6720	Opal	White	General	P	80×10^{-7}	110 480	220 275	40	499 531 775	—	2.58	—	—	—	1.507
6750	Opal	White	Lighting Ware	BPR	87×10^{-7}	110 420	220 220	18	445 475 672	—	2.63	—	—	—	1.513
6810	Opal	White	Lighting Ware	BPR	69×10^{-7}	120 470	240 270	85	496 529 768	—	2.65	—	—	—	1.508
7050	Borosilicate	Clear	Series Sealing	T	46×10^{-7}	200 440	235 235	70	461 496 703	—	2.25	—	16.8	0.33	1.479
7052	Borosilicate	Clear	Kovar Sealing	BMP	46×10^{-7}	200 420	210 210	70	438 475 708	1115	2.28	—	17.9	0.26	1.484
7070	Borosilicate	Clear	Low Loss Electrical	BMP	32×10^{-7}	230 430	230 230	100	455 490	1100	2.13	6.8×10^4	17.4	0.06	1.469
7250	Borosilicate	Clear	Baking Ware	P	36×10^{-7}	230 460	260 260	130	486 524 775	—	2.24	—	15.8	0.28	1.475
7340	Borosilicate	Clear	Gauge Glass	T	67×10^{-7}	120 510	240 310	45	538 575 785	—	2.43	11.5×10^4	16.8	0.69	1.506
7720	Borosilicate	Clear	Electrical	BPT	36×10^{-7}	230 460	260 260	130	484 518 755	1110	2.35	9.5×10^4	16.8	0.27	1.487
7740	Borosilicate	Clear	General	BPTU	32×10^{-7}	230 490	260 290	100	515 555 820	1220	2.23	9.8×10^4	15.8	0.46	1.474
7760	Borosilicate	Clear	Electrical	BP	34×10^{-7}	230 450	250 250	130	475 515 780	1210	2.23	9.1×10^4	17.9	0.18	1.473
7900	96% Silica	Clear	High Temp.	BPTU	8×10^{-7}	800 1090	—	200	820 910 1500	—	3.5	9.7×10^4	17.9	0.05	1.458
7900	96% Silica (Multiform)	White	High Temp.	M	8×10^{-7}	800 1090	—	200	820 910 1500	—	3.5	9.7×10^4	17.9	0.05	1.458
7910	96% Silica	Clear	Ultra Violet Transmission	BTU	8×10^{-7}	800 1090	—	200	820 910 1500	—	3.5	9.7×10^4	17.4	0.024	1.458
7911	96% Silica	Clear	Ultra Violet Transmission	T	8×10^{-7}	800 1090	—	200	820 910 1500	—	3.5	9.7×10^4	17.4	0.019	1.458
8870	High Lead	Clear	Sealing or Electrical	MTU	91×10^{-7}	110 380	180 180	22	398 429 580	—	4.28	7.6×10^4	17.4	0.09	1.493
9700	.....	Clear	Ultra Violet Transmission	TU	37×10^{-7}	220 500	—	80	517 558 804	1195	2.26	—	15.8	—	1.478
9741	.....	Clear	Ultra Violet Transmission	BUT	39×10^{-7}	200 390	—	40	407 442 705	—	2.16	—	17.4	—	—

be very vulnerable to thermal shock. Recommendations in this range are based on mechanical considerations only. Tests should be made before adapting final designs.

From 0° to 300° C in/in/°C or cm/cm/°C

These data approximate only.

Based on plunging sample into cold water after oven heating. Resistance of 100° C means no breakage if

heated to 110° C and plunged into water at 10° C. Tempered samples have over twice the resistance of annealed glass. Glasses 7900, 7910, 7911 cannot be tempered.

Resistance in °C is the temperature differential between the two surfaces of a tube or a constrained plate that will cause a tensile stress of 1000 p.s.i. on the cooler surface.

These data subject to normal manufacturing variations.

COLUMN 11 Data show relative resistance to sandblasting.

COLUMN 12 Units are grams/cc.

COLUMN 14 Data at 25° extrapolated from high temp. readings and are approximate only.

GLASSES 7910 AND 7911 Electrical properties measured on lamp worked specimens. Courtesy, Corning Glass Works, 1952

Checked 1956

Whiteware

Mechanical and Electrical Properties of Electrical Porcelain Products*

Property	Unit	An economical type of porcelain for use in most applications. Can be glazed in a wide range of colors. Feldspathic Porcelain A dark colored porcelain which will not show assembly soiling. Can be glazed black, brown, or blue. Feldspathic Porcelain Excellent for difficult shapes that must withstand severe mechanical strain and at the same time exhibit good thermal shock resistance. Special Stoneware A refractory insulation for use in electrical heating equipment where very rapid changes of temperature take place. Tops in its line. Refractory High dielectric and mechanical strength with very low water absorption. Superior to commercial grade porcelain in this respect. Feldspathic Porcelain A highly porous material used in humidifiers and air conditioning equipment where desirable to contain moisture for gradual release. Highly Porous Refractory Widely used for small parts where high electrical resistance at elevated temperatures is required, such as in heaters, ovens and toasters. Semi-Steatite Used for small parts where low cost is important. Excellent thermal shock resistance. Refractory									
Type of Body		White	Slate	Gray	Buff	White	White	Ivory	Buff		
Color											
True Specific Gravity		2.53	2.56	2.76	2.43	2.41	2.66	2.76	2.67		
Bulk Specific Gravity		2.37	2.40	2.53	1.90	2.37	1.82	2.34	2.16		
Weight Per Cubic Inch	Lbs./cu. in.	0.086	0.087	0.091	0.068	0.086	0.066	0.085	0.078		
Water Absorption	Percent	1.4	1.3	1.4	13.7	0.4	17.2	4.2	7.2		
Pore Volume	Percent	6.2	6.1	8.5	23.6	1.4	31.4	14.9	19.0		
Linear Coefficient of Thermal Expansion $\times 10^{-6}$	25°—100° C.	4.13	2.93	3.60	2.27	4.00	10.67	6.67	3.33		
	25°—400° C.	4.88	4.43	5.67	2.96	5.07	11.77	7.47	3.15		
	25°—700° C.	5.67	5.22	6.97	2.95	5.73	13.50	7.94	3.17		
Coefficient of Thermal Conductivity†	c. g. s.	0.0043	0.0044	0.0053	0.0045	0.0043	0.0040	0.0047	0.0045		
Softening Temperature	Degrees F.	2900°	2880°	2900°	2570°	2800°	3050°	2450°	2450°		
	Degrees C.	1593°	1582°	1593°	1410°	1538°	1677°	1343°	1343°		
Thermal Shock Resistance		Fair	Fair	Good	Excellent	Fair	Good	Good	Excellent		
Tensile Strength	Lbs./sq. in.	2,440	2,630	2,910	1,190	3,330	380	3,670	1,580		
Compressive Strength	Lbs./sq. in.	49,100	45,600	56,600	17,100	67,300	10,100	54,100	20,900		
Flexural Strength	Lbs./sq. in.	5,360	5,370	6,310	3,390	6,760	1,540	7,370	5,170		
Resistance to Impact‡	Inch-Lbs.	2.4	2.3	2.4	1.7	2.5	1.6	2.5	1.7		
T _m Value§	Degrees F.	680°	680°	1020°	1370°	680°	1240°	1010°	1150°		
	Degrees C.	360°	360°	549°	743°	360°	671°	543°	622°		
volume Resistivity at 200° C.		120	140	—	—	150	—	—	—		
Various Temperatures		5.0	5.0	—	—	5.6	—	120	—		
800° C.		0.4	0.4	28.0	86.0	0.4	80.0	14.0	45.0		
Dielectric Strength	Volts/mil.	—	—	2.9	16.5	—	11.0	2.0	6.0		
Dielectric Constant		—	—	0.5	4.1	—	2.4	0.4	1.3		
Power Factor¶		—	—	—	1.4	—	0.7	—	0.4		
Loss Factor‡		—	—	—	0.7	—	—	—	—		
		35	39	48	38	106	35	46	33		
		5.4	5.4	5.4	3.9	5.3	3.7	5.3	4.6		
		0.0112	0.0123	0.0054	0.0089	0.0104	0.0199	0.0048	0.0101		
		0.060	0.067	0.029	0.036	0.054	0.069	0.025	0.047		

*Measurements shown are average values from test specimens. Semi-Steatite and Refractory (last column) specimens were dry "dust pressed"; all others were wet "dust pressed."

†The linear coefficient of thermal expansion is the expansion per unit length per degree Centigrade.

‡The coefficient of thermal conductivity is the number of calories transmitted per second across one square centimeter area through one centimeter thickness with a temperature difference of one degree Centigrade.

§Charpy method, using one-half inch diameter rods between 4 inch centers.

¶T_m Value is the temperature at which a centimeter cube of the material has a resistance of one megohm.

¶These tests were run at a frequency of one megacycle. All specimens were measured dry.

Courtesy Star Porcelain Co., 1956

Layout of Pumpless Slip Distribution System

Effect of Temperature on Viscosity of Decal Varnish

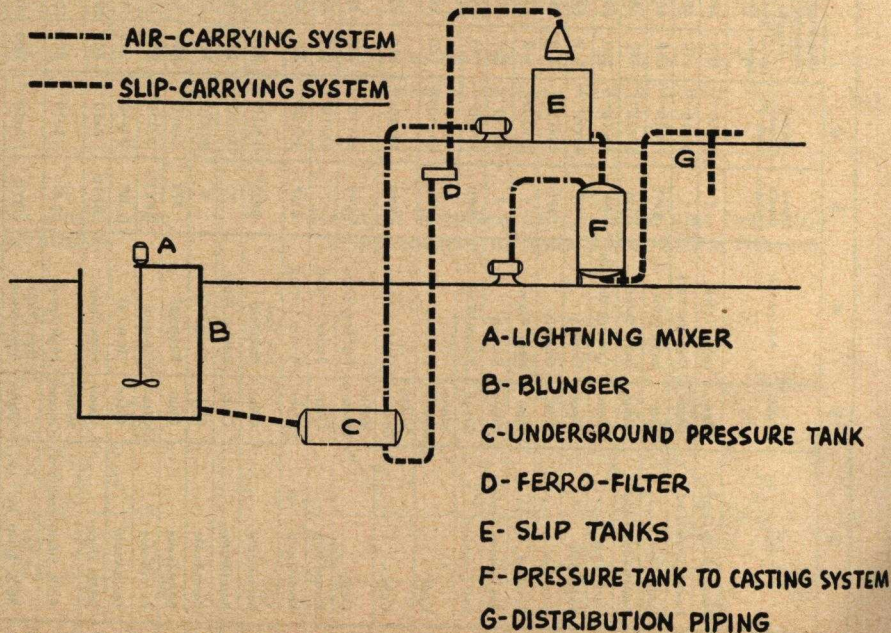
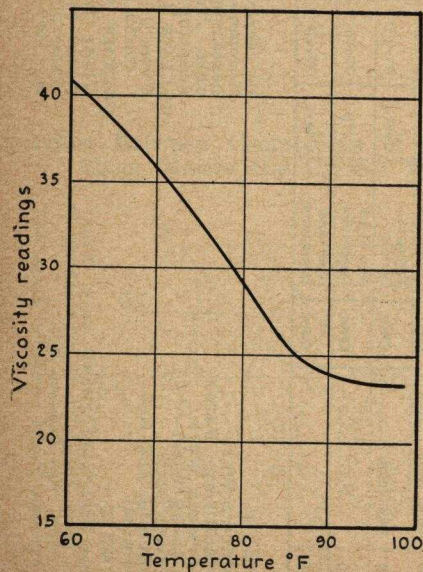


Diagram shows layout of pumpless, non-circulatory slip distribution system in use at Max Well pottery, Los Angeles producer of dinnerware and artware. In over three years of operation, the lines or pressure vessels of this efficient system have never required cleaning. Pressures used in the system range from 30 psi to 36 psi.

Checked 1956

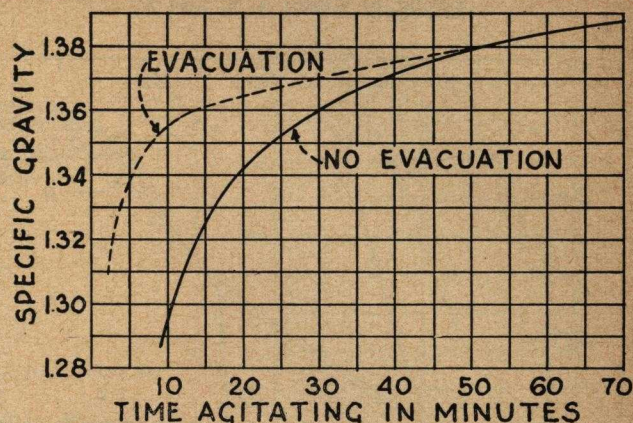
Effect of the Amount of Binder on the Physical Characteristics of a Talc-Water System

(Low Pressure Extrusion)

TYPE OF BINDER	Per Cent Added	Dry Shrinkage in Per Cent	Warping in Per Cent	Dry Modulus of Rupture Lb./Sq. In.	Water of Plasticity Per Cent
Wheat Flour	1	3.3	3	50	26.6
	3	5.7	3	110	29.0
	5	7.3	4	120	33.7
Gum Ghatti	1	5.3	5	660	23.4
	3	4.7	22	2070	23.5
	5	3.3	17	2420	23.0
Methyl Cellulose	0.6	5.0	4	250	24.9
Polyvinyl Alcohol	1	5.3	7	1230	23.8
	3	6.3	3	440	25.4
	3	6.3	7	2120	24.8
	5	4.0	6	3760	21.0

Checked 1956, Sierra Talc & Clay Co.

The Effect of Evacuation on Blunging a Pottery Slip



Checked by J. R. Beam, 1956

Effect of De-Airing Plaster on Mold Life

Mix* Number	Absorption		Wet Density		Dry Density		Mod. of Rupture Lbs./Sq. In.	
	De-aired	Not de-aired	De-aired	Not de-aired	De-aired	Not de-aired	De-aired	Not de-aired
1	33.75%	35.14%	1.476	1.471	1.145	1.134	1251	1008
2	40.00	42.60	1.437	1.433	1.015	1.000	960	826
3	45.91	48.36	1.409	1.405	.960	.937	660	610

(Vacuum used was equivalent to 29.0 inches of mercury.)

*Mixes tested were:

1. 100 parts by weight of plaster to 70 parts by weight of water.
2. 100 parts by weight of plaster to 80 parts by weight of water.
3. 100 parts by weight of plaster to 90 parts by weight of water.

Checked 1956, by U. S. Gypsum Co.

Standard Dimensions Data for Jacketed and Unjacketed Glass-Lined Pipe

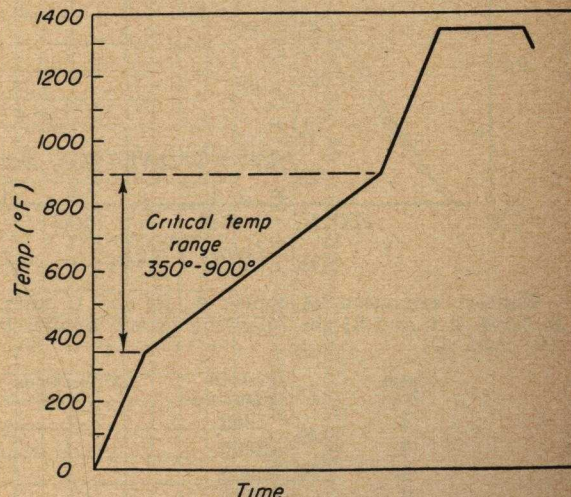
CASE No.	MATERIAL	WALL "L" THICKNESS	WALL (k) THERM. COND.	k/L (BTU/hr./sq.ft./°F)
1	Stainless Steel	.063"	105	1670
2	Carbon-resin bonded Karbate	.125"	900	7200
3	Glass Pipe	.1875"	8.1	43
4	Glass-lined steel pipe	.05" glass .154" steel	6.0 360	120 2340
				= 114 combined

NOM. SIZE G.L. PIPE	APPROX. I.D. AFTER LINING	FT. REQ'D PER SQ. FT. INT. SURFACE	TRANSVERSE AREA FOR PRODUCT FLOW	O.D. OF G. L. PIPE	STEEL THICKNESS	I.D. OF JACKET PIPE	ANNULAR AREA FOR COOLING OR HEATING MEDIUM
ins.	inches	ft.	sq. ft.	inches	inches	inches	sq. ft.
1½	1.53	2.5	.0128	1.9	.145	3	.0294
2	2.0	1.91	.0218	2.375	.154	4	.0565
3	3.0	1.28	.0491	3.5	.216	5	.0695
4	3.96	0.965	.0854	4.5	.237	6	.0858
6	6.0	0.636	.1964	6.625	.280	8	.1091
8	7.9	0.483	.3410	8.625	.318	10	.1394
10	9.94	0.384	.5390	10.75	.365	12	.1554
12	11.85	0.322	.7660	12.75	.400	14	.1840

NOTE: 1½" pipe may be only lined in lengths up to 3'0". All other sizes are available in lengths up to and including 10'0".

Courtesy, The Pfaunder Co., 1956

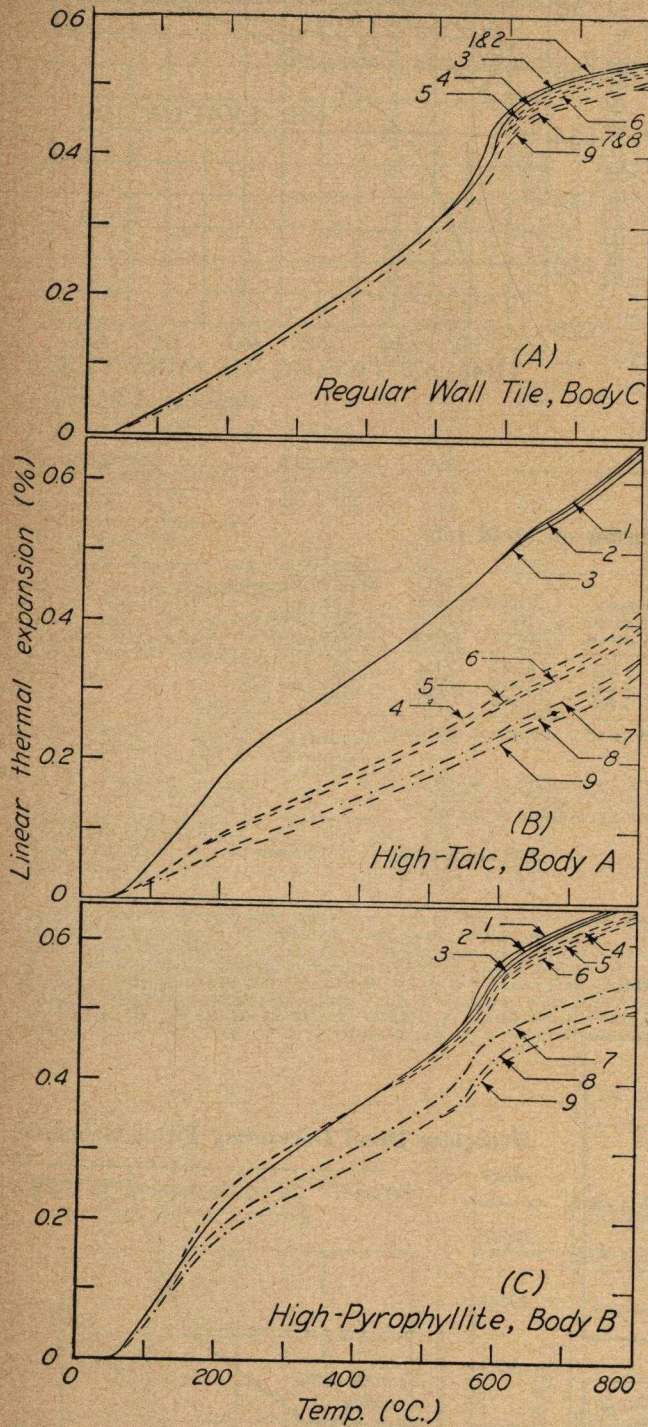
Overglaze Decal Decorating Firing Schedule



In hardening on underglaze decal the same slow firing rate as shown in this curve eliminated blistering difficulties.

Checked by Universal Potteries, Inc., 1956

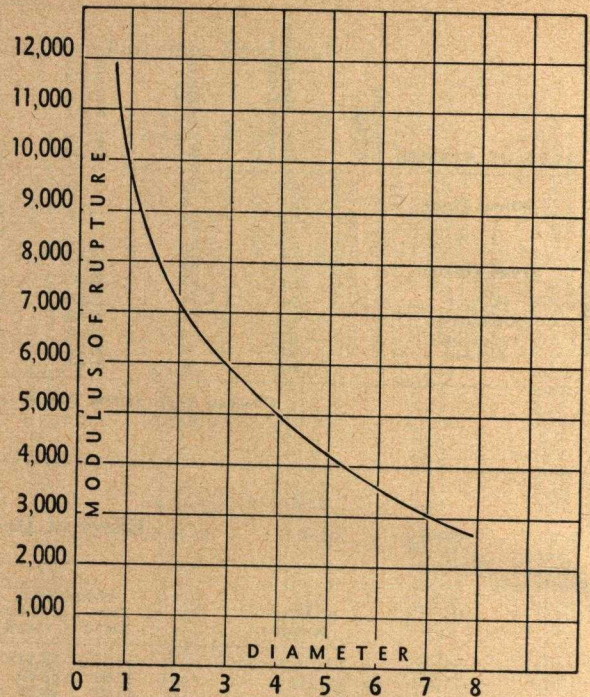
Thermal Expansion of Wall Tile Bodies, After Firing to Cones 4, 6, and 8



Thermal expansion of bodies A, B, and C after firing to cones 4, 6 and 8; the following legend applies to (A), (B), and (C)

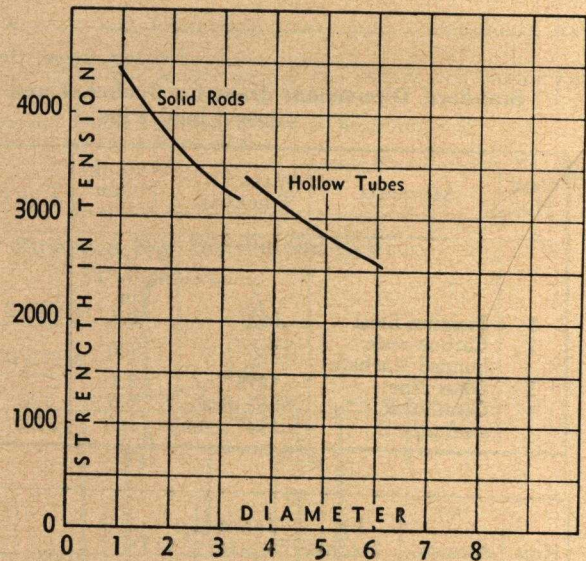
Curve No.	Pressure (lb./sq. in.)	Firing temp. (Cone)
1	1000	4
2	2000	4
3	3000	4
4	1000	6
5	2000	6
6	3000	6
7	1000	8
8	2000	8
9	3000	8

Typical Curve Showing Relation of Modulus of Rupture to Diameter in Porcelain Insulators



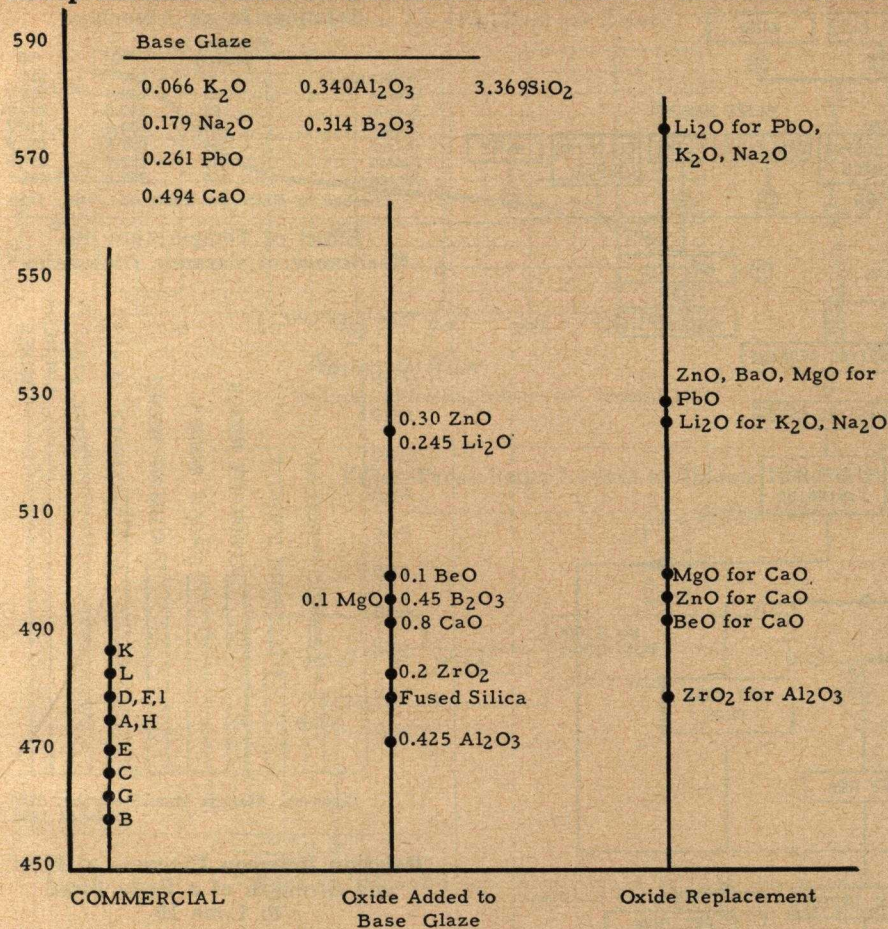
Courtesy, Locke Insulator Corp., 1956

Typical Curve Showing Relation of Tensile Strength to Diameter in Porcelain Insulators



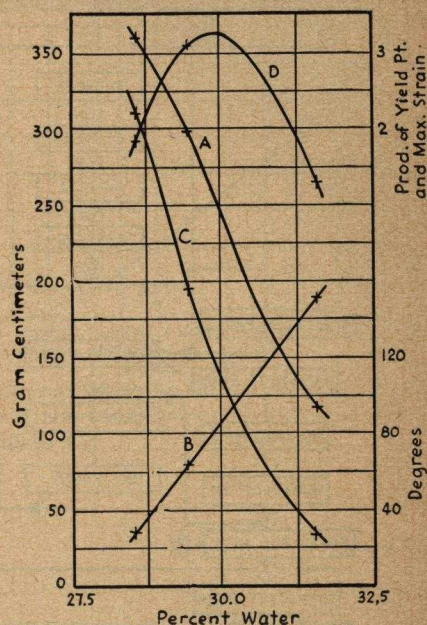
Courtesy, Locke Insulator Corp., 1956

Knoop Hardness Values of Conventional and Modified Chinaware Glazes



Jour. Amer. Ceram Soc., 33 (1) 1-8 (1950); Koch, Harman and O'Bannon
Checked 1956

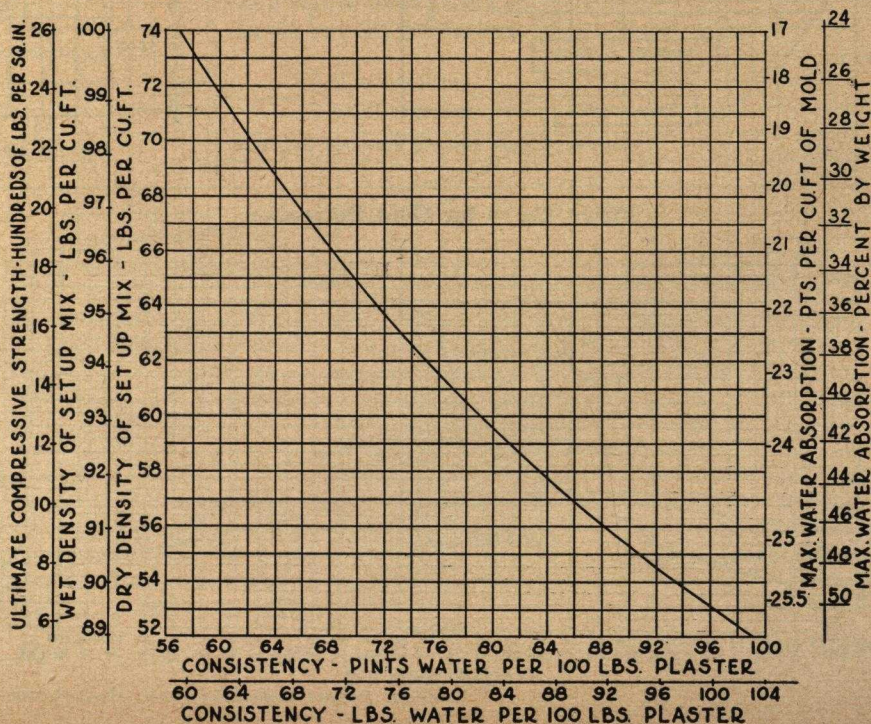
Effect of Water Content on Ball Clay



A = Maximum Strength; B = Maximum Deformation; C = Yield Point; D = Product of Yield Point and Maximum Deformation.

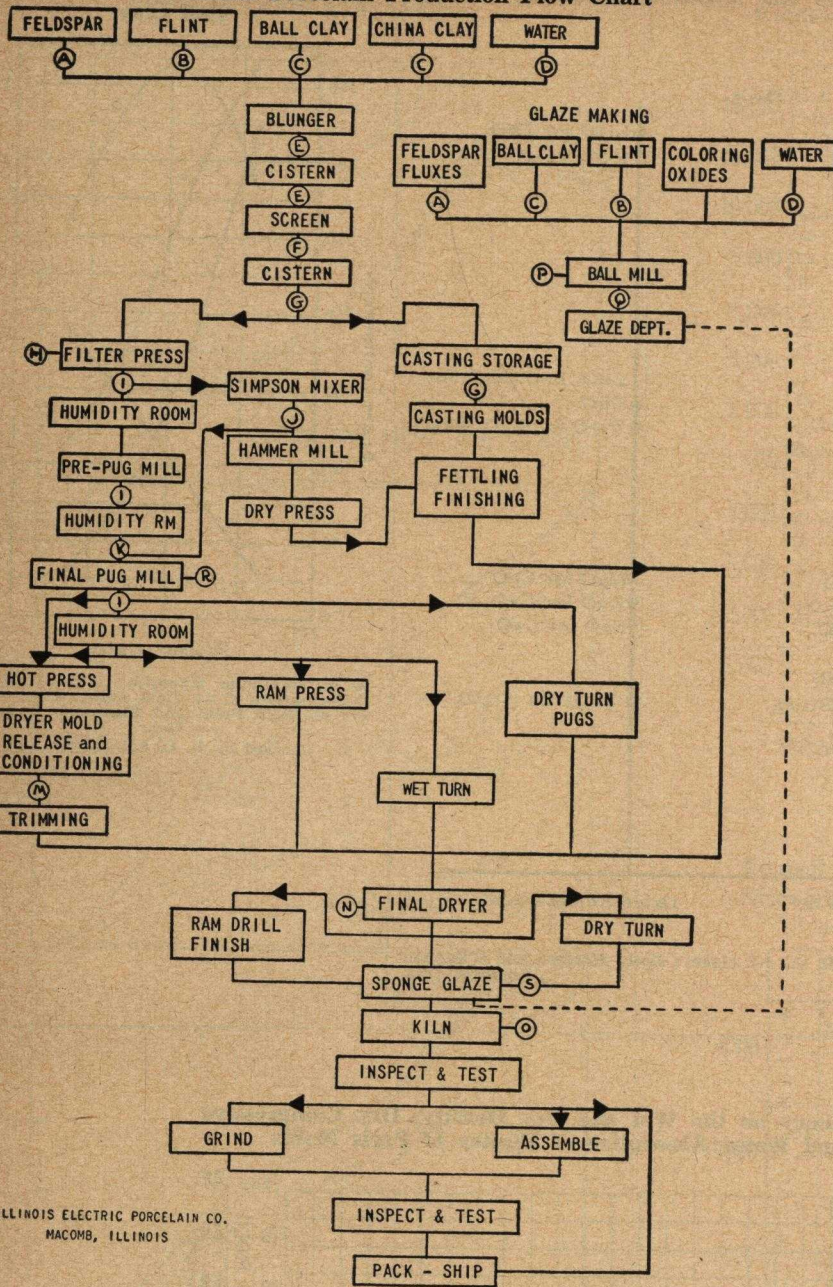
Checked by H. C. Spinks Clay Co., 1956

Effect of Consistency on the Wet and Dry Density, Dry Compressive Strength and Water Absorption of Plaster of Paris Molds



Checked 1956 by United States Gypsum Co.

Electrical Porcelain Production Flow Chart



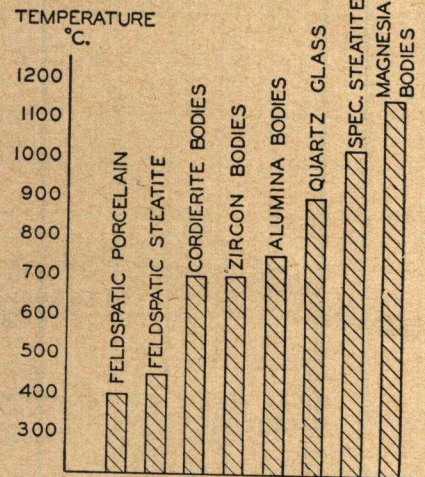
Courtesy, Illinois Electric Porcelain Co., 1956

Temperature and Gage Pressure Relations in an Autoclave

	Pressure in pounds	°C	°F
Atmosphere	0	100	212
Steam	25	130.4	266.7
Steam	50	147.6	297.7
Steam	100	169.9	337.8
Steam	150	185.8	365.9
Steam	200	197.7	387.9
Steam	250	207.8	406

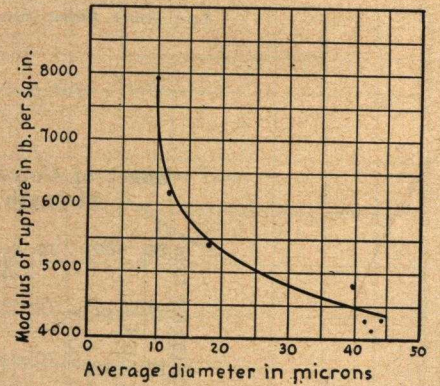
Checked by Patterson-Kelley Co., Inc., 1956

Effect of Temperature on Resistance of Ceramic Dielectrics



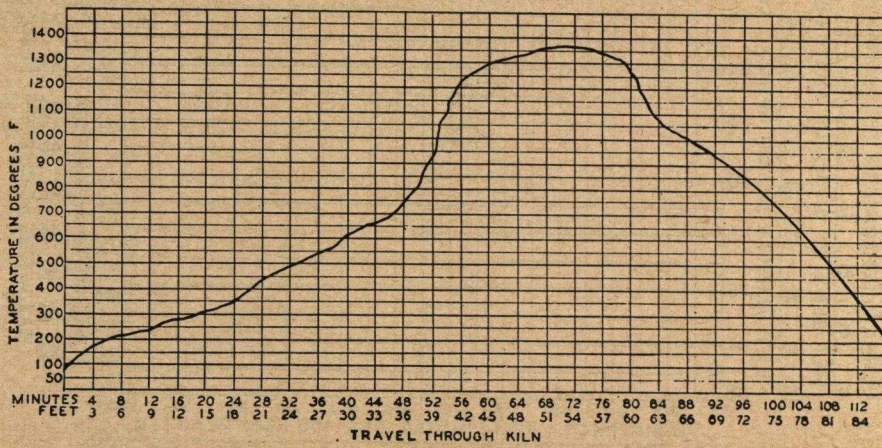
Courtesy, Electric Manufacturing, 1950
Checked 1956

Relation Between Fineness of Flint and Strength of a Body Fired to Cone 10



Checked 1956

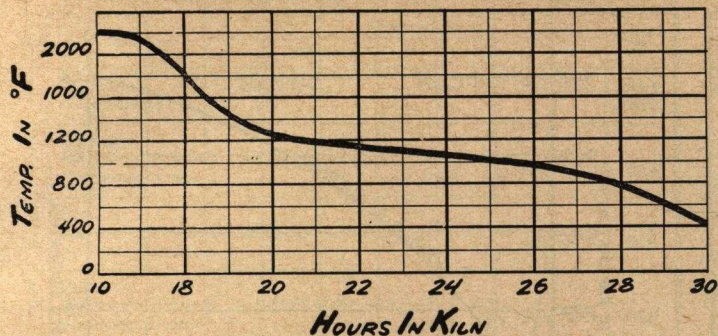
Firing Curve for Gold Decoration



Courtesy, Surface Combustion Corp. Checked 1956

Controlled Cooling Minimizes Possibilities of Dunting

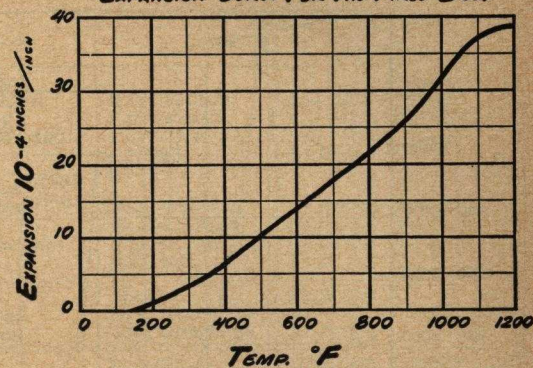
A DESIRABLE KILN CURVE COOLING ZONE



Courtesy, Richmond Radiator Co., Checked 1954

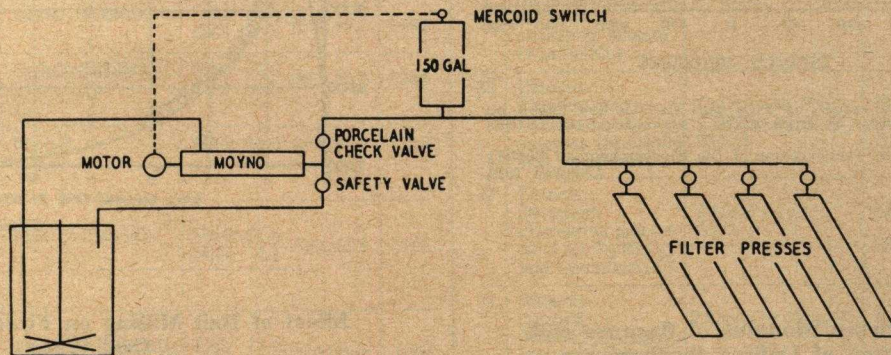
Reduced Thermal Expansion of Body Decreases Dunting Tendency

EXPANSION CURVE FOR THE FIRED BODY



Courtesy, Richmond Radiator Co., Checked 1954

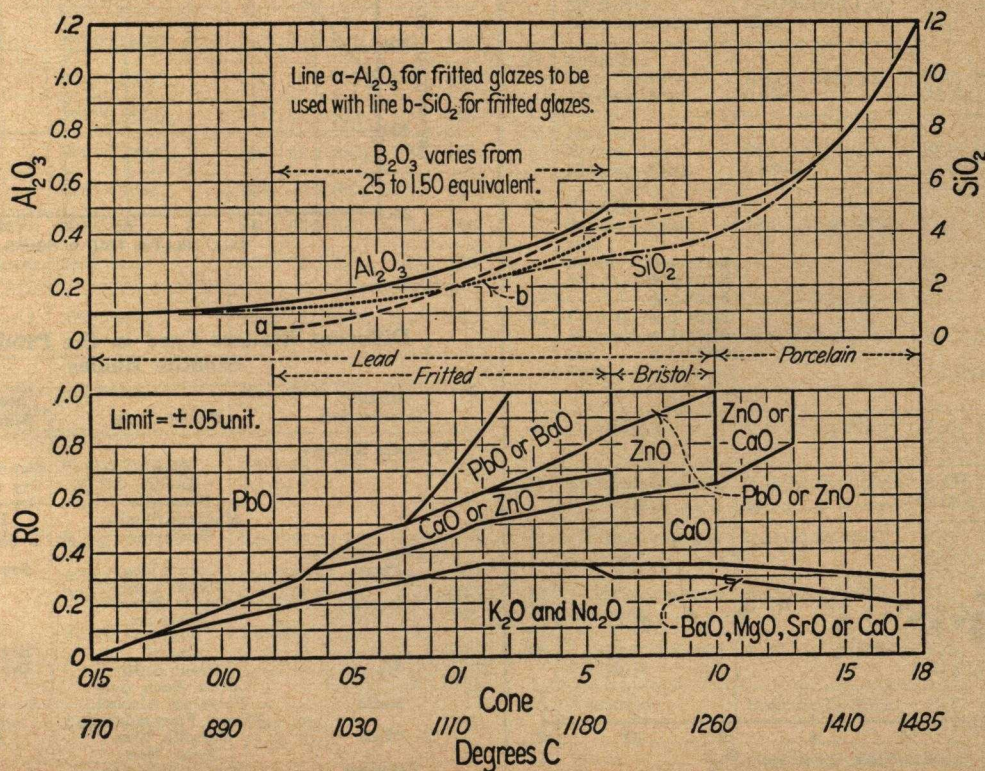
Filter-Press Room Layout at Illinois Electric Porcelain Co.



Pressure in 150 gallon tank is maintained at 75-85 plus or minus p.s.i. by mercoid switch operating the Moyno pump motor

Checked 1954, by Illinois Electric Porcelain Co.

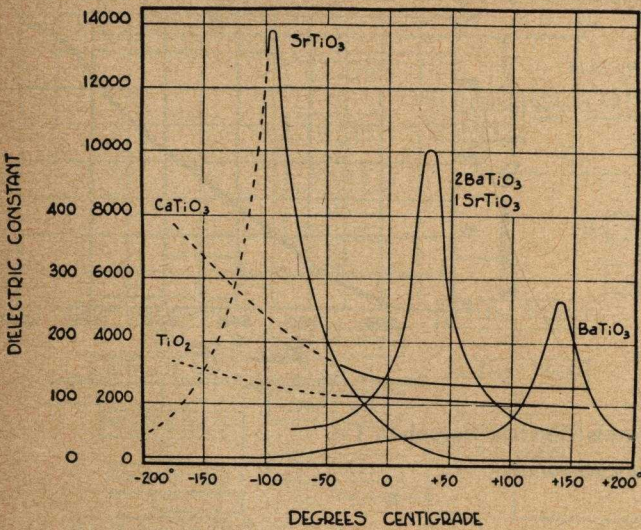
Glaze Composition Chart



Glaze composition chart showing glaze ingredients plotted against temperature.—Chart taken from J.A.C.S. 1934 Holscher and Watts

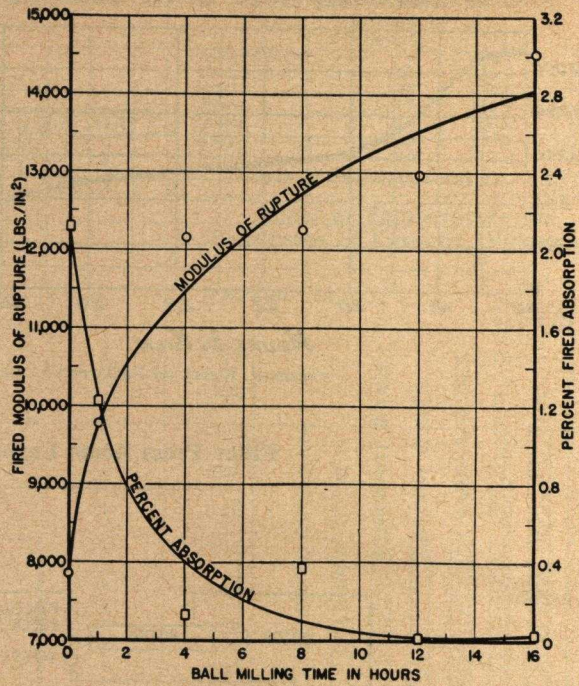
Checked 1966

Dielectric Constant vs. Temperature of Rutile and Titanate Bodies



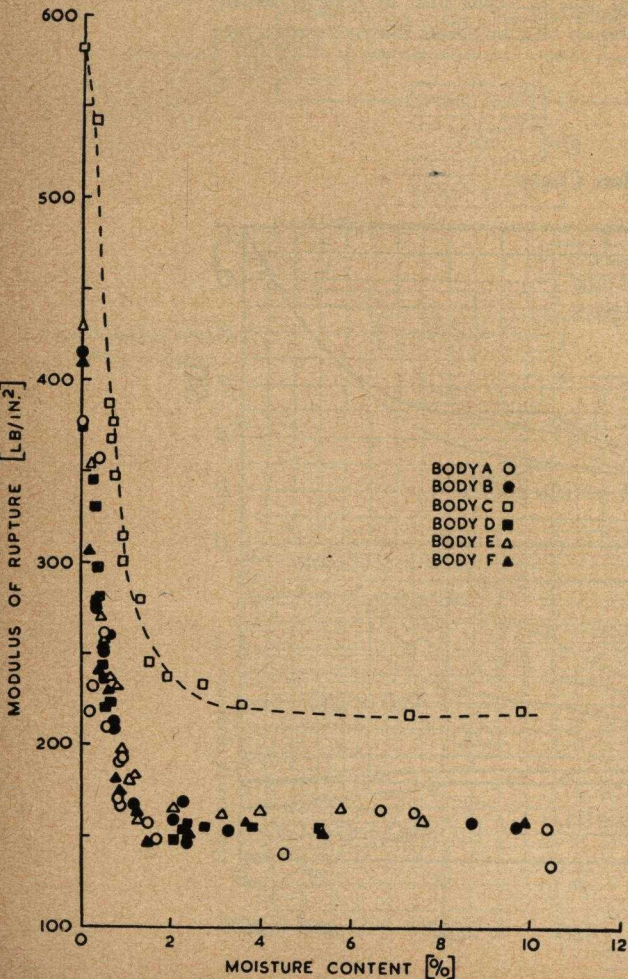
The dielectric constant values of TiO_2 and CaTiO_3 are based on lower scale; all others refer to high scale. All values are at one megacycle per second.
From Transactions of the Electrochemical Society
Checked 1956

Effect of Ball Milling on Dry Strength of Cast Ware



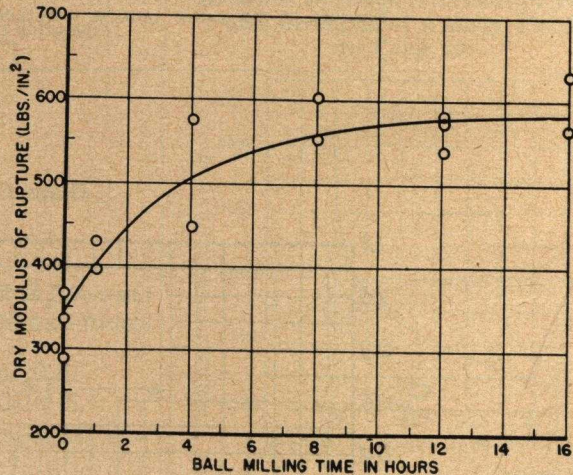
Courtesy, JACS, March, 1949
Checked 1956

Relationship Between Modulus of Rupture and Moisture Content of Unfired Earthenware



Courtesy, British Ceramic Research Assn., 1956

Effect of Ball Milling on Fired Properties of Cast Ware



Checked 1956

Different Binders Used in the Production of Steatite Bodies

Binder Classification	Binder Type	Means to Add the Binder to the Body
Ceramic Binders	Clay	Dry or In Suspension
	Kaolin	Dry or In Suspension
	Bentonite	Dry or In Suspension
	Montmorillonite	Dry or In Suspension
	Hectorite	In Suspension
Organic Binders	Flour	In Suspension
	Corn Flour	Dry or In Solution
	Gluten Flour	Dry or In Solution
	Potato Starch	Dry or In Solution
	Dextrine	In Solution
	Arabic	In Solution
	Ghatti	In Solution
	Tragacanth	In Solution
	Locust Bean Gum	In Solution
	Polyvinyl Alcohol	In Solution
Resin	Phenol Formaldehyde	In Solution
	Paraffin Wax	In Emulsion
	Carbo Wax	In Solution
	Methyl Cellulose	In Solution
Cellulose Acetate		

Checked 1956, by Stupakoff Ceramic Mfg. Co.

Glaze Components—Eutectic Mixtures and Melting Points

No.	Substance	COMPOSITION		Melting Point, °C.
		Molecular	Percentage	
1	Sodium metasilicate	$\text{Na}_2\text{O} \cdot \text{SiO}_2$	Na_2O 50.7 SiO_2 49.3	1018 1086
2	Eutectic : Na metasilicate & Ca metasilicate	$3.8\text{Na}_2\text{SiO}_3 \cdot \text{CaSiO}_3$	Na_2O 40.6 CaO 9.6 SiO_2 49.8	932
3	Eutectic : Na metasilicate & Sr metasilicate	$\text{SrSiO}_3 \cdot 5.33\text{Na}_2\text{SiO}_3$	Na_2O 40.5 SrO 12.6 SiO_2 46.9	875
4	Eutectic : Na metasilicate & Ba metasilicate	$\text{BaSiO}_3 \cdot 2.62\text{Na}_2\text{SiO}_3$	Na_2O 30.4 BaO 28.7 SiO_2 40.9	908
5	Calcium fluoride	CaF_2		1378
6	Eutectic : Ca fluoride and Ca metasilicate	$\text{CaF}_2 \cdot 1.09\text{CaSiO}_3$	CaF_2 38.1 CaO 29.8 SiO_2 32.1	1130
7	Ca metasilicate & Ferrous silicate	$\text{CaSiO}_3 \cdot 4\text{FeSiO}_3$	FeO 44.6 CaO 8.7 SiO_2 46.7	1030
8	Calcium and Manganese metasilicates	$\text{CaSiO}_3 \cdot 7\text{MnSiO}_3$	MnO 47.9 CaO 5.4 SiO_2 46.7	1134
9	Manganese metasilicate (Rhodonite)	MnSiO_3	MnO 54.0 SiO_2 46.0	1216
10	Eutectic : Manganese metasilicate and manganese sulphide	$\text{MnS} \cdot 13.3\text{MnSiO}_3$	MnO 51.5 MnS 4.7 SiO_2 43.8	1130
11	Eutectic : Zinc and cadmium metasilicates	$\text{ZnSiO}_3 \cdot 1.75\text{CdSiO}_3$	ZnO 17.2 CdO 47.6 SiO_2 35.2	1052
12	Cadmium metasilicate	$\text{CdO} \cdot \text{SiO}_2$	CdO 68.0 SiO_2 32.0	1155

(a) See also "Melting Point"; an Encyclopedia of the Ceramic Industry, A. B. Searle, London, 1930, Vol. II, p. 309-310.

No.	Substance	COMPOSITION		Melting Point, °C.
		Molecular	Percentage	
13	Lead oxide	PbO		876
14	Mixtures of lead oxide with silica	$\text{PbO} \cdot 0.04\text{SiO}_2$	PbO 98.8 SiO_2 1.2	540
15	Ditto	$\text{PbO} \cdot 0.20\text{SiO}_2$	PbO 94.5 SiO_2 5.5	526
16	Ditto	$\text{PbO} \cdot 0.26\text{SiO}_2$	PbO 92.9 SiO_2 7.1	508
17	Ditto	$\text{PbO} \cdot 0.29\text{SiO}_2$	PbO 92.2 SiO_2 7.8	560
18	Ditto	$\text{PbO} \cdot 2.40\text{SiO}_2$	PbO 60.6 SiO_2 39.4	661
19	Lead orthosilicate	$2\text{PbO} \cdot \text{SiO}_2$	PbO 88.1 SiO_2 11.9	746
20	Lead metasilicate	$\text{PbO} \cdot \text{SiO}_2$	PbO 78.7 SiO_2 21.3	770
21	Eutectic : Lead oxide and Lead orthosilicate	$3\text{PbO} \cdot \text{SiO}_2$	PbO 91.7 SiO_2 8.3	552
22	Eutectic : Lead orthosilicate & Lead metasilicate	$3\text{PbO} \cdot 2\text{SiO}_2$	PbO 84.7 SiO_2 15.3	690
23	Eutectic : Lead-Alumina- Silica	$\text{PbO} \cdot 0.254\text{Al}_2\text{O}_3 \cdot 1.91\text{SiO}_2$	PbO 61.2 SiO_2 31.7 Al_2O_3 7.1	650
24	Mixtures of Cuprous oxide and Silica	$5\text{Cu}_2\text{O} \cdot \text{SiO}_2$	Cu_2O 92.23 SiO_2 7.77	1074
	Ditto	$4\text{Cu}_2\text{O} \cdot \text{SiO}_2$	Cu_2O 90.47 SiO_2 9.53	1089
	Ditto	$3\text{Cu}_2\text{O} \cdot \text{SiO}_2$	Cu_2O 87.69 SiO_2 12.31	1050, 80
	Ditto	$2\text{Cu}_2\text{O} \cdot \text{SiO}_2$	Cu_2O 82.61 SiO_2 17.39	1062
	Ditto	$\text{Cu}_2\text{O} \cdot \text{SiO}_2$	Cu_2O 70.36 SiO_2 29.64	1042
			Eutectic at 1048	1115, 70
25	Calcium ferrite	$\text{CaO} \cdot \text{Fe}_2\text{O}_3$	CaO 26.0 Fe_2O_3 74.0	1203
26	Nepheline	$\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	Na_2O 21.8 Al_2O_3 35.8 SiO_2 42.4	1223

No.	Substance	COMPOSITION		Melting Point, °C.
		Molecular	Percentage	
27	Eutectics : Potash-Silica Ditto Potash-Alumina- Silica	$\text{K}_2\text{O} \cdot 1.291\text{SiO}_2$ $\text{K}_2\text{O} \cdot 7.430\text{SiO}_2$ $\text{K}_2\text{O} \cdot 0.276\text{Al}_2\text{O}_3 \cdot 6.978\text{SiO}_2$	K_2O 55.0 SiO_2 45.0 K_2O 17.5 SiO_2 82.5 K_2O 17.3 Al_2O_3 5.2 SiO_2 77.5	780 880 870
28	Eutectics : Soda-Silica Soda-Alumina- Silica	$\text{Na}_2\text{O} \cdot 0.972\text{SiO}_2$ $\text{Na}_2\text{O} \cdot 4.579\text{SiO}_2$ $\text{Na}_2\text{O} \cdot 0.185\text{Al}_2\text{O}_3 \cdot 4.550\text{SiO}_2$	Na_2O 51.5 SiO_2 48.5 Na_2O 18.4 SiO_2 81.6 Na_2O 17.8 Al_2O_3 5.1 SiO_2 77.1	830 860 800
29	Eutectic : Albite and orthoclase	Approx. 68% Albite and 42% Orthoclase	Na_2O 6.8 K_2O 7.1 SiO_2 67.1 Al_2O_3 19.0	Approx. 1160
30	Lithium metasilicate	$\text{Li}_2\text{O} \cdot \text{SiO}_2$	Li_2O 33.2 SiO_2 66.8	1180
31	Eutectic : Calcium alumi- num silicate, Silica and α -Calcium silicate ($\alpha\text{CaO} \cdot \text{SiO}_2$)	$\text{CaO} \cdot 0.35\text{Al}_2\text{O}_3 \cdot 2.48\text{SiO}_2$	CaO 23.25 Al_2O_3 14.75 SiO_2 62.0	1170
32	Eutectic : Calcium and sodium aluminium silicates (Anorthite and Nepheline)	$\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ $2.275(\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2)$	Na_2O 15.6 CaO 5.8 SiO_2 42.6 Al_2O_3 36.0	1130
33	Eutectic : Strontium aluminium silicate ($\text{SrO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$) and Strontia (SrO)	$2.5\text{SrO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	SrO 53.7 Al_2O_3 21.2 SiO_2 25.1	Approx. 1290
34	Eutectic : Celsian ($\text{BaO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$) and Baryta (BaO)	$2.5\text{BaO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	BaO 63.2 Al_2O_3 16.9 SiO_2 19.9	Approx. 1220
35	Eutectic : Magnesia and Calcined Kaolin ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$)	$2\text{MgO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	MgO 26.6 Al_2O_3 33.6 SiO_2 39.8	Approx. 1330

No.	Substance	COMPOSITION		Melting Point, °C.
		Molecular	Percentage	
36	Eutectic : Magnesia- Alumina-Silica	$\text{MgO} \cdot 0.392\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	MgO 20.0 Al_2O_3 20.0 SiO_2 60.0	1350
37	Eutectic : Zinc Oxide- Alumina-Silica	$\text{ZnO} \cdot 0.225\text{Al}_2\text{O}_3 \cdot 0.9\text{SiO}_2$	ZnO 51.3 Al_2O_3 14.5 SiO_2 34.2	1360
38	Eutectic : Barium Oxide- Alumina-Silica	$\text{BaO} \cdot 0.43\text{Al}_2\text{O}_3 \cdot 4.0\text{SiO}_2$	BaO 35.0 Al_2O_3 10.0 SiO_2 55.0	1200
39	Eutectic : Ferrous oxide and Kaolin (Calcined) ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$)	$2\text{FeO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	FeO 39.2 Al_2O_3 27.8 SiO_2 33.0	Approx. 1210
40	Eutectic : Manganous oxide and Kaolin (Calcined) ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$)	$2\text{MnO} \cdot \text{Al}_2\text{O}_3 \cdot \text{SiO}_2$	MnO 38.9 Al_2O_3 28.0 SiO_2 33.1	Approx. 1120
41	Orthoclase	$\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$	K_2O 16.9 Al_2O_3 18.3 SiO_2 64.8	1220
42	2 Orthoclase and 3 Quartz	$\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 7.5\text{SiO}_2$	K_2O 14.5 Al_2O_3 15.7 SiO_2 69.8	1265
43	1 Orthoclase and 2 Quartz	$\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 8\text{SiO}_2$	K_2O 13.8 Al_2O_3 15.0 SiO_2 71.2	1285
44	1 Orthoclase and 3 Quartz	$\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 9\text{SiO}_2$	K_2O 12.7 Al_2O_3 13.8 SiO_2 73.5	1292
45	1 Orthoclase and 6 Quartz	$\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 12\text{SiO}_2$	K_2O 10.2 Al_2O_3 11.1 SiO_2 78.7	1317
46	Anorthite	$\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	CaO 20.1 Al_2O_3 36.6 SiO_2 43.3	1550
47	Albite	$\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$	Na_2O 11.8 Al_2O_3 19.4 SiO_2 68.8	Below 1200

Glaze Components—Eutectic Mixtures and Melting Points

No.	Substance	COMPOSITION			Fusion Completed
		Molecular	Percentage	Incipient Fusion	
48	1 Albite and 5 Anorthite	0.09 Na ₂ O } 0.91 CaO } 1.00 Al ₂ O ₃ }	2.36 Na ₂ O 1.9 CaO 16.9 Al ₂ O ₃ 33.9	SiO ₂ 47.3	1465 1521
49	1 Albite and 2 Anorthite	0.2 Na ₂ O } 0.8 CaO } 1.0 Al ₂ O ₃ }	2.8 Na ₂ O 3.8 CaO 13.7 Al ₂ O ₃ 31.2	SiO ₂ 51.3	1372 1490
50	1 Albite and 1 Anorthite	0.33 Na ₂ O } 0.67 CaO } 1.00 Al ₂ O ₃ }	3.33 Na ₂ O 5.7 CaO 10.4 Al ₂ O ₃ 28.3	SiO ₂ 55.6	1287 1450
51	2 Albite and 1 Anorthite	0.5 Na ₂ O } 0.5 CaO } 1.0 Al ₂ O ₃ }	4 Na ₂ O 7.7 CaO 6.9 Al ₂ O ₃ 25.3	SiO ₂ 60.1	1205 1394
52	3 Albite and 1 Anorthite	0.6 Na ₂ O } 0.4 CaO } 1.0 Al ₂ O ₃ }	4.4 Na ₂ O 8.7 CaO 5.2 Al ₂ O ₃ 23.9	SiO ₂ 62.2	1175 1362
53	8 Albite and 1 Anorthite	0.8 Na ₂ O } 0.2 CaO } 1.0 Al ₂ O ₃ }	5.2 Na ₂ O 10.5 CaO 2.4 Al ₂ O ₃ 21.5	SiO ₂ 65.6	— 1265
54	Boric Oxide	B ₂ O ₃			Melting Point, °C. 294
55	Sodium metaborate	Na ₂ O·B ₂ O ₃	Na ₂ O 47.0 B ₂ O ₃ 53.0		965
55a	Anhydrous Borax	Na ₂ O·2B ₂ O ₃	Na ₂ O 30.7 B ₂ O ₃ 69.3		741
56	Eutectic : Na and K metaborates	K ₂ O·B ₂ O ₃ ·1.24 (Na ₂ O·B ₂ O ₃)	K ₂ O 28.7 Na ₂ O 23.5	B ₂ O ₃ 47.8	855
57	Potassium metaborate	K ₂ O·B ₂ O ₃	K ₂ O 57.4 B ₂ O ₃ 42.6		968
58	Eutectic : Na and Li metaborates	Li ₂ O·B ₂ O ₃ ·1.43 (Na ₂ O·B ₂ O ₃)	Li ₂ O 10.4 Na ₂ O 30.7	B ₂ O ₃ 58.9	640
59	Maximum melting point mixture Na metaborate & Na metaphosphate	Na ₂ O·B ₂ O ₃ ·Na ₂ O·P ₂ O ₅	Na ₂ O 36.9 P ₂ O ₅	B ₂ O ₃ 20.8	800

No.	Substance	COMPOSITION		Melting Point, °C.
		Molecular	Percentage	
72	Strontium baborate	SrO·2B ₂ O ₃	SrO 42.5 B ₂ O ₃ 57.5	Approx. 930
73	Eutectic : Sr baborate and Sr metaborate	SrO·1.58B ₂ O ₃	SrO 48.2 B ₂ O ₃ 51.8	Approx. 890
74	Strontium metaborate	SrO·B ₂ O ₃	SrO 59.7 B ₂ O ₃ 40.3	1100
75	Eutectic : Sr metaborate and Sr pyroborate	SrO·0.71B ₂ O ₃	SrO 67.6 B ₂ O ₃ 32.4	980
76	Strontium pyroborate	2SrO·B ₂ O ₃	SrO 74.7 B ₂ O ₃ 25.3	Approx. 1115
77	Barium metaborate	BaO·B ₂ O ₃	BaO 68.7 B ₂ O ₃ 31.3	1050
78	Eutectic : Ba metaborate and Ba pyroborate	BaO·0.64B ₂ O ₃	BaO 77.4 B ₂ O ₃ 22.6	750
79	Barium pyroborate	2BaO·B ₂ O ₃	BaO 81.4 B ₂ O ₃ 18.6	1000
80	Barium orthoborate	3BaO·B ₂ O ₃	BaO 86.8 B ₂ O ₃ 13.2	Over 1300
80a	Mixtures of Magnesium Oxide with Boric Oxide	MgO·B ₂ O ₃ 2MgO·B ₂ O ₃ 3MgO·B ₂ O ₃	MgO 36.6 B ₂ O ₃ 63.4 MgO 53.6 B ₂ O ₃ 46.4 MgO 63.5 B ₂ O ₃ 36.5	988 1340 1366
81	Thallium metaborate	Tl ₂ O·B ₂ O ₃	Tl ₂ O 85.8 B ₂ O ₃ 14.2	350
82	Cupric metaborate	CuO·B ₂ O ₃	CuO 53.2 B ₂ O ₃ 46.8	Approx. 980
83	Cuprous sesquiborate	3Cu ₂ O·2B ₂ O ₃	Cu ₂ O 75.4 B ₂ O ₃ 24.6	950-1000
84	Cadmium metaborate	CdO·B ₂ O ₃	CdO 64.7 B ₂ O ₃ 35.3	875

* H. M. Davies and M. A. Knight, J. Amer. Ceram. Soc., Vol. 28, pp. 97-102, 1945.

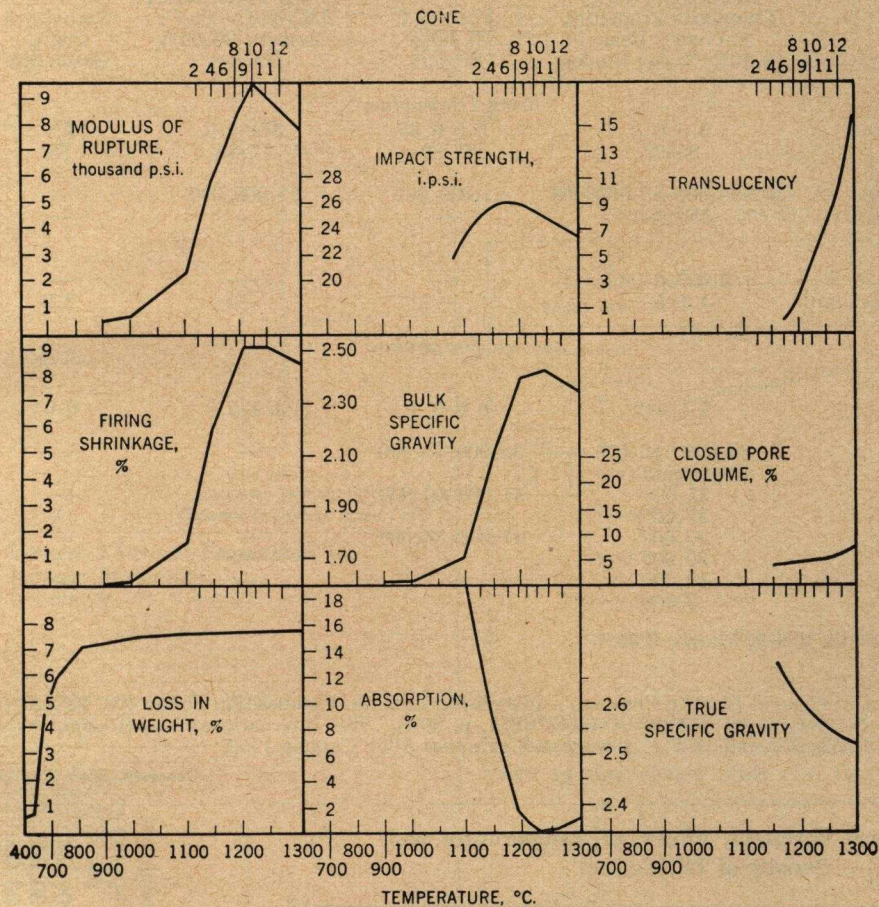
No.	Substance	COMPOSITION		Melting Point, °C.
		Molecular	Percentage	
60	Sodium metaphosphate	Na ₂ O·P ₂ O ₅	Na ₂ O 30.4 P ₂ O ₅ 69.6	610
61	Eutectic : Na metaborate & Na metasilicate	Na ₂ SiO ₃ ·1.52 (Na ₂ O·B ₂ O ₃)	Na ₂ O 48.9 SiO ₂ 27.1	B ₂ O ₃ 24.0 815
62	Eutectic : Li metaborate & Li metasilicate	Li ₂ SiO ₃ ·4.66 (Li ₂ O·B ₂ O ₃)	Li ₂ O 30.9 SiO ₂ 18.7	B ₂ O ₃ 50.4 802
63	Eutectic : K metaborate and the double salt KBO ₂ ·KPO ₃	KPO ₃ ·3.37KBO ₂	K ₂ O 45.7 P ₂ O ₅ 20.4	B ₂ O ₃ 33.9 770
64	K metaborate and K metaphosphate	KBO ₂ ·KPO ₃	K ₂ O 47.1 P ₂ O ₅ 35.4	B ₂ O ₃ 17.5 885
65	Eutectic : K metaphosphate and the double salt KBO ₂ ·KPO ₃	KBO ₂ ·6.25KPO ₃	K ₂ O 41.7 P ₂ O ₅ 54.0	B ₂ O ₃ 4.3 681
66	Potassium metaphosphate	K ₂ O·P ₂ O ₅	K ₂ O 39.9 P ₂ O ₅ 60.1	823
67	Calcium baborate	CaO·2B ₂ O ₃	CaO 28.6 B ₂ O ₃ 71.4	Approx. 1025
68	Eutectic : Ca baborate and Ca metaborate	2CaO·3B ₂ O ₃	CaO 34.8 B ₂ O ₃ 65.2	Approx. 990
69	Calcium metaborate	CaO·B ₂ O ₃	CaO 44.4 B ₂ O ₃ 55.6	1095
70	Eutectic : Ca metaborate and Ca pyroborate	CaO·0.83B ₂ O ₃	CaO 49.1 B ₂ O ₃ 50.9	Approx. 1060
71	Calcium pyroborate	2CaO·B ₂ O ₃	CaO 61.5 B ₂ O ₃ 38.5	Approx. 1215

No.	Substance	COMPOSITION		Melting Point, °C.
		Molecular	Percentage	
84a	Mixtures of Lead oxide with Boric oxide	4PbO·B ₂ O ₃ 2PbO·B ₂ O ₃ 5PbO·4B ₂ O ₃ PbO·2B ₂ O ₃	PbO 92.7 B ₂ O ₃ 7.3 PbO 86.4 B ₂ O ₃ 13.6 PbO 79.9 B ₂ O ₃ 20.1 PbO 61.4 B ₂ O ₃ 38.6	565 497 548 768
84b	Eutectic : Lead oxide-Boric oxide	2.303PbO·B ₂ O ₃	PbO 88 B ₂ O ₃ 12	493
85	Eutectic : Lead oxide-Boric oxide-Silica	PbO·0.238B ₂ O ₃ ·0.78SiO ₂	PbO 77.8 B ₂ O ₃ 5.8 SiO ₂ 16.4	485
86	Eutectic : Soda-Boric oxide-Silica	Na ₂ O·1.29B ₂ O ₃ ·1.73SiO ₂	Na ₂ O 24.2 B ₂ O ₃ 35.2 SiO ₂ 40.6	790
87	Eutectic : Potash-Boric oxide-Silica	K ₂ O·2.11B ₂ O ₃ ·2.85SiO ₂	K ₂ O 22.8 B ₂ O ₃ 35.7 SiO ₂ 41.5	630
88	Fluorite	CaF ₂		1361
89	Cryolite	AlF ₃ ·3NaF	AlF ₃ 40.0 NaF 60.0	998
90	Eutectic : Cryolite and Fluorite		AlF ₃ 29.8 CaF ₂ 25.4 NaF 44.8	905
91	Sodium fluoride	NaF		1040
92	Potassium fluoride	KF		885
93	Potassium Cryolite	AlF ₃ ·3KF	KF 50.9 AlF ₃ 49.1	1035
94	Eutectic : Sodium fluoride and Lead fluoride	NaF·2.1PbF ₂	NaF 7.8 PbF ₂ 92.2	540
95	Lead fluoride	PbF ₂		855
96	Eutectic : Potassium fluoride and Barium fluoride	KF·1.2BaF ₂	KF 78.7 BaF ₂ 21.3	750
97	Barium fluoride	BaF ₂		1280

† R. F. Geller and E. N. Bunting, Journ. Research, Nat. Bur. Standards, Vol. 18, pp. 588-593 (5), 1937

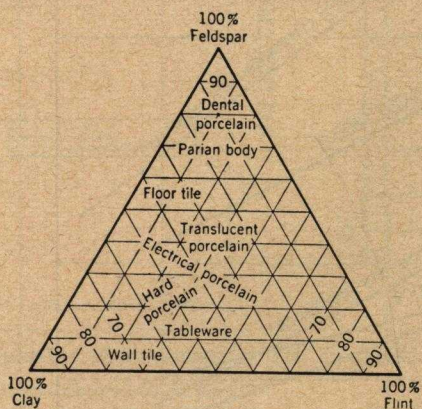
Courtesy, United States Borax & Chem. Corp., Pacific Coast Borax Div., 1956

Effect of Heat Treatment on the Physical Properties of a Whiteware Body



Courtesy, Encyclopedia of Chemical Technology, 1957

Triaxial Diagram Showing Areas of Commercial Wares



Courtesy, Encyclopedia of Chemical Technology, 1957

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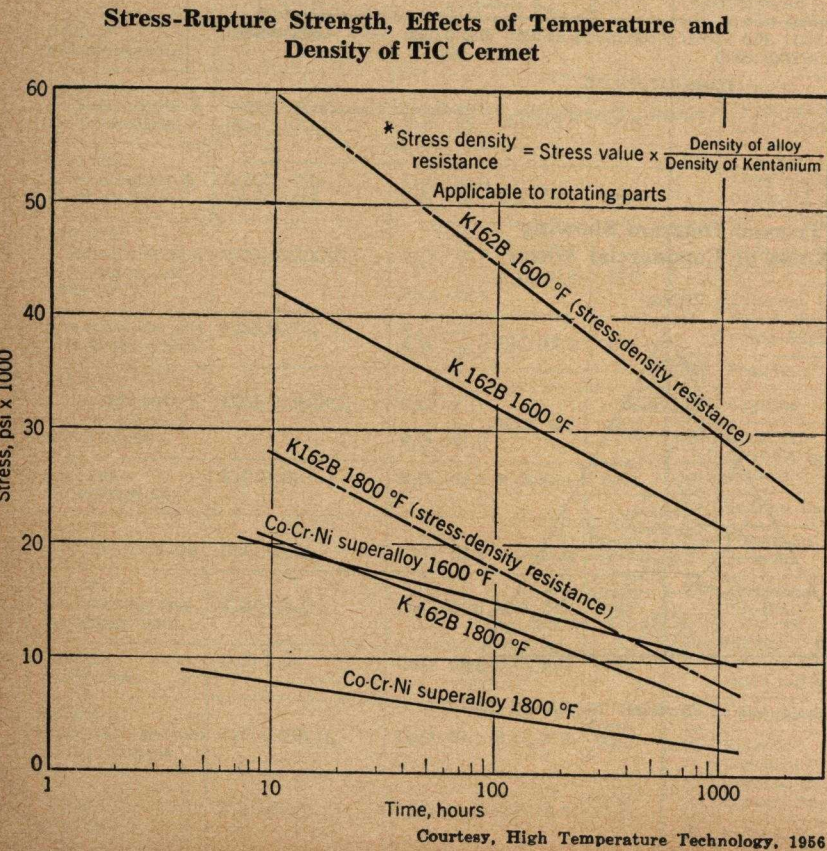
Electronics and New Ceramics

Comparative Physical Properties of Carbide Cermets and Superalloys

Property	Kentanium, TiC,* Composite Properties of Grades Using 10-40% Nickel Binders	Firthite,† 37-50% Binders	H. M. Tools, Ltd.,‡ TiC-Ni-Cr-Co-Cr Cermets, 20-60% Binders	Carboloy,§ Cr ₃ C ₂ , Grade 608	Superalloys || Range for Several Co-Cr-Ni and High-Ni-Cr Alloys
Room Temperature					
Density, g·cm ⁻³	5.5-6.5	6.0-6.55	5.4-6.9	7.0	8.3-8.7
Hardness, Rockwell A	83-93	81-89	77-89	88	61-65
Modulus of elasticity, psi (representative values)	36,000,000-55,000,000	51,000,000	51,000,000	—	30,000,000
Compressive strength, psi	550,000	—	—	—	—
Conductivity					
Thermal, cal·sec ⁻¹ ·cm ⁻² ·cm·°C ⁻¹	0.072-0.085	—	—	—	0.035-0.065
Electrical, % copper standard	1.9-5	—	—	2.2	1.37-1.8
High Temperature					
Thermal expansion in·in·°F ⁻¹ × 10 ⁻⁶ to 1200°F	4.5-6.2	6.0-6.2	4.4-5.0	6.0	6.73-8.5
Tensile strength, psi, at 21°C (70°F)	80,000-155,000 (representative)	33,000-75,000	—	—	110,000-180,000
820°C (1500°F)	55,000	51,000-60,000	—	—	52,000-73,000
870°C (1600°F)	47,000	—	—	—	34,000-51,000
980°C (1800°F)	40,000	41,000-35,000	—	—	9,000-25,500
1090°C (2000°F)	30,000	—	—	—	13,100
1200°C (2200°F)	12,500	—	—	—	—
1320°C (2400°F)	3,000	—	—	—	—

* Kennametal Inc., Bulletin 1052A, March, 1954.¹⁴
† Firth Sterling Inc.¹³
‡ Hard Metal Tools, Ltd.¹²
§ Carboloy Department of General Electric Company, Advertising Bulletin, Composition Grade 608, 83% Cr₃C₂-2% WC-15% Ni.²²
|| Super Alloys, Metal Progress Data Sheet, November, 1951, p. 80-B. The International Nickel Company Inconel "X" Catalog, January, 1949. Haynes-Stellite Division, U.C.C. Corporation, Haynes Alloy Catalog 1950.

Courtesy, High Temperature Technology, 1956

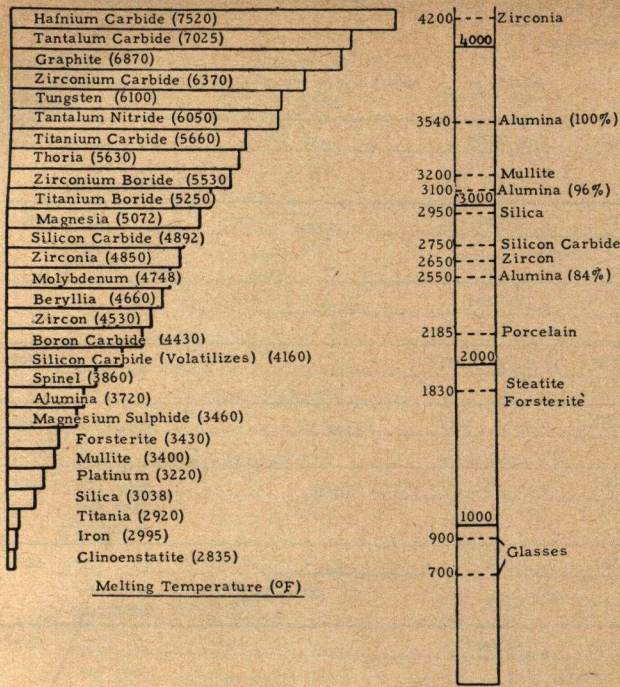


Physical Properties of TiC Cermets

Nominal Composition, Weight %		Modulus of Rupture, psi		Density, Hardness, RA	
TiC	Cr ₃ C ₂	Cr	Co	Density, g·cm ⁻³	Hardness, RA
74	4	—	—	5.80	89
63	7	—	—	5.90	85
48	12	—	—	6.25	84
47.5	2.5	—	—	6.40	81.5
52	8	—	—	6.80	77.5
80	—	—	20	5.40	89
63	—	—	30	5.90	87.5
48	—	—	40	6.29	87.0
45	—	—	50	6.45	84
32	—	—	60	6.88	81

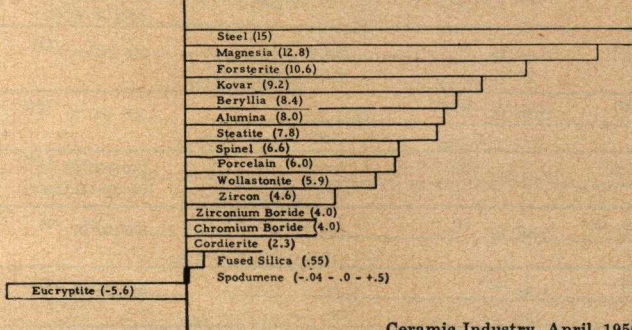
Courtesy, High Temperature Technology, 1956

Thermal Properties of Ceramic Materials



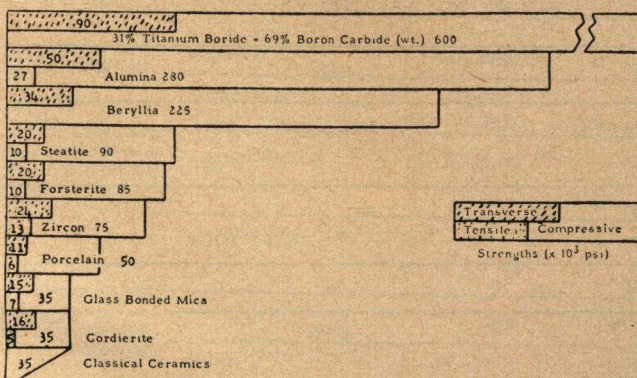
Ceramic Industry, April 1956

Coefficient of Linear Thermal Expansion of Ceramic Materials (Room Temperature 700° C (1292°F.))



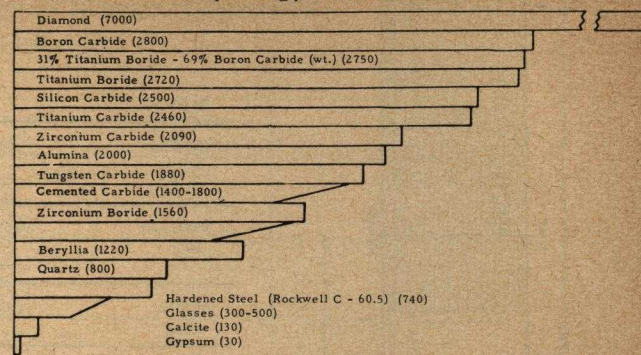
Ceramic Industry, April, 1956

Tensile, Transverse and Compressive Strengths of Ceramic Materials



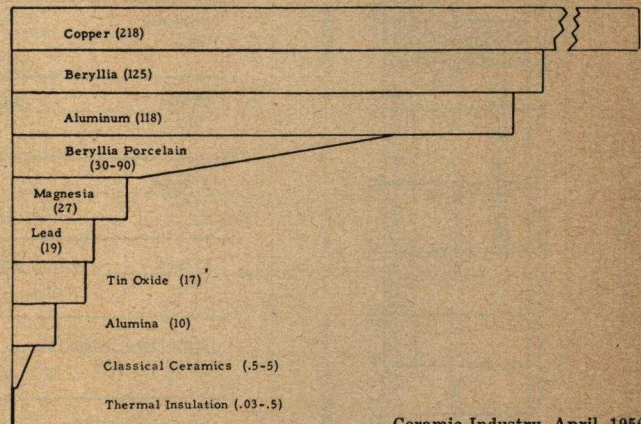
Ceramic Industry, April, 1956

Hardness (Knoop) of Ceramic Materials



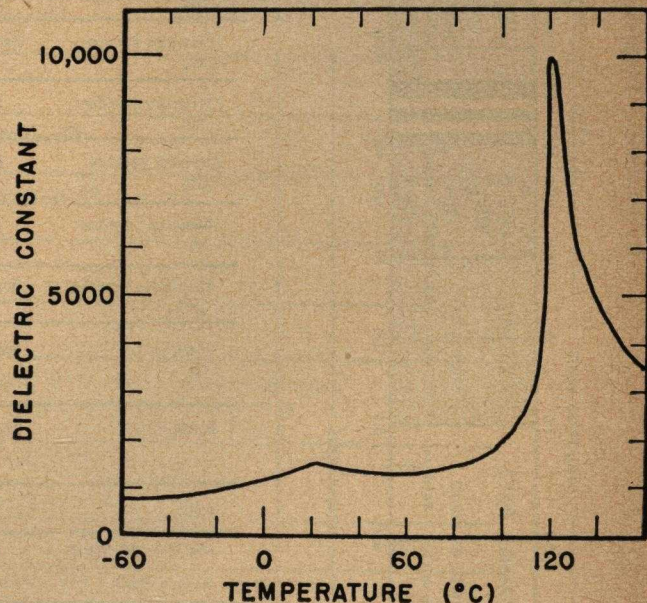
Ceramic Industry, April, 1956

Thermal Conductivity of Ceramic Materials (B.T.U./(Hr.) (Sq. Ft.) / (°F./Ft.) at 140°F.



Ceramic Industry, April, 1956

Dielectric Constant of Barium Titanate as a Function of Temperature. The Peak at 120°C., the Curie Temperature Is Associated with the Onset of Ferroelectricity



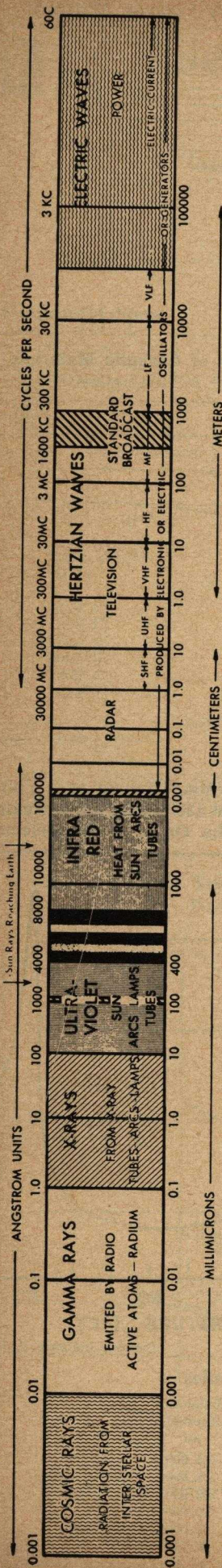
Ceramic Industry, April, 1956

Physical Properties of Commercial TiC Cermets, Firthite Grades

Grade	Nominal Composition, Weight %					Density, g.cm ⁻³	Hardness, RA	Modulus of Rupture, psi
	TiC	Ni	Co	Cr	Cr ₃ C ₂			
FS-2	63	29.6	—	7.4	—	6.00	87.2	175,000
FS-5	63	—	25.9	11.1	—	6.15	89.5	158,000
FS-8	63	22.2	7.4	7.4	—	6.05	87.5	162,000
FS-9	50	30.0	10.0	10.0	—	6.40	82.5	170,000
FS-26	54.3	40.0	—	—	5.7	6.25	85.0	165,000
FS-27	42.9	50.0	—	—	7.1	6.55	81.0	180,000

Courtesy, High-Temperature Technology, 1956

A Schematic Diagram of the Electromagnetic Spectrum



Physical and Nuclear Properties of Selected Refractories

MATERIAL	Mp °C	Density * g per cc	Thermal Neutron Absorption cross Section cm ² /cc	Coefficient of Thermal Conductivity G. Cal. Sec ⁻¹ °C ⁻¹ Cm ⁻² Cm
Alumina Al ₂ O ₃	2015 ± 15 (13)	3.79 (22)	.0101	.069 (100°C) (22) .021 (600°C) .013 (1200°C)
Beryllia BeO	2530 ± 30 (3)	2.86 (22)	.00074	.500 (100°C) (22) .107 (600°C) .039 (1200°C)
Hafnia HfO ₂	2900 ± 25 (9)	9.68 (18)	3.18	-
Gadolinia Gd ₂ O ₃	2350 ± 20 (28)	7.40 th. (16)	1090.	Ca. .005(1000°C) (28)
Samarita Sm ₂ O ₃	2350 ± 20 (28)	7.43 th. (16)	167.	Ca. .005(1000°C) (28)
Magnesia MgO	2800 (25)	3.58 (34)	.0032	.082 (100°C) (22) .028 (600°C) .014 (1200°C)
Thoria ThO ₂	3220 ± 50 (23)	9.6 (28)	.160	.020 (100°C) (22) .008 (600°C) .0078 (1200°C)
Titania TiO ₂	1830 (34)	4.17 (34)	.176	.015 (100°C) (22) .008 (600°C) .0076 (1200°C)
Urania UO ₂	2878 ± 22 (23)	10.02 (28)	.165	.018 (100°C) (22) .008 (600°C) .006 (1000°C)
Stabilized Zirconia ZrO ₂ (5% CaO)	2600 (8)	5.35 (22)	.00571	.004 (100°C) (22) .004 (600°C) .0049 (1200°C)
Beryllium Carbide Be ₂ C	d. 2100 (18)	2.44 th. (7)	.0010	.056 (20°C) (12)
Boron Carbide B ₄ C	2450 (27)	2.51 th. (27)	82.0	.065 (20°C) (27)
Silicon Carbide SiC	d. 2200 (12)	3.2 th. (12)	.00647	.049 (600°C) (17) (Recrystallized)
Tantalum Carbide TaC	3600 ± 150 (5)	14.48 th. (1)	.964	.053 (20°C) (1)
Titanium Carbide TiC	3140 (27)	4.93 (27)	.277	.041 (20°C) (1)
Uranium Carbide UC ₂	2400 (25)	11.28 th. (25)	.192	.082 (20°C) (30) (10 g/cc density)
Tungsten Carbide WC	2777 (25)	15.70 th. (25)	.915	-
Zirconium Carbide ZrC	3530 ± 125 (5)	6.7 (27)	.0072	.049 (20°C) (1)
Graphite Cg	3700 ± 100 (11)	1.55 (22)	.000350	.298 (100°C) (22) .154 (600°C) .105 (1000°C)
Boron	2300 ± 300 (11)	2.3 (16)	96.	-
MoSi ₂	1870 (1)	6.2 (1)	.065	.075 (20°-200°C) (1)
80% SiC-20% C-1% S1	1400** (28)	3.1 (28)	.00659	.5 (50°C) (28) .08 (1000°C)
72% Cr-28% Al ₂ O ₃	1300** (33)	5.95 (33)	.147	.04 (20°C) (38)
30% Cr-70% Al ₂ O ₃	1300** (4)	4.68 (4)	.056	.023 (20°C) (4)
80% TiC-20% Ni (K-151a)	1200** (21)	5.8 (21)	.311	.080 (20°C) (21)

d - decomposes
Symbols
I - Cast and sintered
II - Extruded and sintered
III - Cold Pressed and Sintered
IV - Hot Pressed

F - Fuel Elements
M - Moderator
R - Reflector
C - Control Devices
S - Structural Parts
Sn - Neutron Shield

Physical and Nuclear Properties of Selected Refractories

(continued from opposite page)

Lin. Coef. of Thermal Exp. $\times 10^6$ /°C	Young's Modulus of Elasticity $\times 10^6$ psi	Specific Heat cal/gm°C	Preferred Methods of Fabrication	Possible Thermal Reactor Application
6(20°C) (32) 7(500°C) 9(1000°C)	52(20°C) (32) 50(800°C) 32(1400°C)	.21(20°C) (32) .25(500°C) .28(1000°C)	I, II, III	F-S
8(100°C) (32) 8(500°C) 9(1000°C)	45(20°C) (32) 28(800°C) 12(1400°C)	.24(20°C) (32) .50(500°C)	IV, III, II, I	F-M-R-S
5.8(250-1300°C) (9)	8.2(20°C) (28) (Sintered 1500°C)	.174(400°C) (28) .197(1000°C)	I, II, III, IV	C-Sh
10.5(25-1000°C) (28)	18.0(20°C) (28)	.176(400°C) (28) .1956(1000°C)	I, II, III	C-Sh
9.9(25-1000°C) (28)	26.5(20°C) (28)	.179(400°C) (28) .205(1000°C)	I, II, III	C-Sh
11(100°C) (32) 13(500°C) 15(1000°C)	12(20°C) (32)	.23(20°C) (32) .26(500°C) .28(1000°C)	I, II, III	F-S
8(100°C) (32) 9(500°C) 9(1000°C)	21(20°C) (32) 18(800°C) 14(1400°C)	.058(50°C) (16)	I, II, III	F-S
7.5(100-500°C) (12)	12.7-15.5(20°C) (14)	.168(°C) (16)	I, II, III	S
11.2(27-1280°C) (6)	25(20°C) (28)	.058(17°C) (28)	I, II, III, IV	F-S
7.2(70-1000°C) (8)	36(20°C) (12)	.12(20°C) (32) .16(500°C)	I, II, III	S
10.8(38-982°C) (12)	45(20°C) (7) (6-8% Porosity)	-	IV	F-M-R-f
4.5(25-800°C) (31)	65(20°C) (12)	.443(25°C) *** (20)	IV	C-Sh
4.7(20-1500°C) (12)	-	.143(0°C) (24)	I, II, III, IV	F-S
8.2 ± .8(20-2380°C) (12)	-	-	IV	S
7.42(24-500°C) (37)	51(20°C) (35) (Sintered with 5% Co)	.201(25°C) *** (20)	IV	S
-	-	.035(100°C) *** (19)	IV	F
5.2(20°C) (2) 7.3(1930°C)	102.5(20°C) (1)	-	IV	S
6.73(24-500°C) (37)	49(20°C) (27) (Hot Pressed)	-	IV	F-S
3.34(25-1800°C) (12)	1.0(20°C) (29)	ca. .3(20°C) (14)	Extrusion and graphitizing at 3000°C followed by machining	F-M-R-S
8.3(20-750°C) (12)	-	.307(50°C) (15) .472(500°C) .510(900°C)	IV	C-Sh
-	-	-	IV	F-S
4.2(20°C) (28)	35.8(20°C) (28)	.228(400°C) (28) .252(700°C) .267(1000°C)	Impregnation of the formed carbon or SiC with Si	F-S
5.85(25-800°C) (33)	47.2(25°C) (33)	-	I, III, IV	F-S
8.65(25-800°C) (4) 9.45(25-1315°C)	52.3(25°C) (4)	-	I, III, IV	F-S
5.0(25-1000°C) (21)	56.7(1000°C) (21)	-	III, IV	S

* Bulk Density except as noted thus th. for theoretical.

Note: Values shown used in calculating thermal nuclear absorption cross sections.

** Maximum long time service temperature

*** Calculated

Compiled by W. E. Moody, N. C. State College, 1956

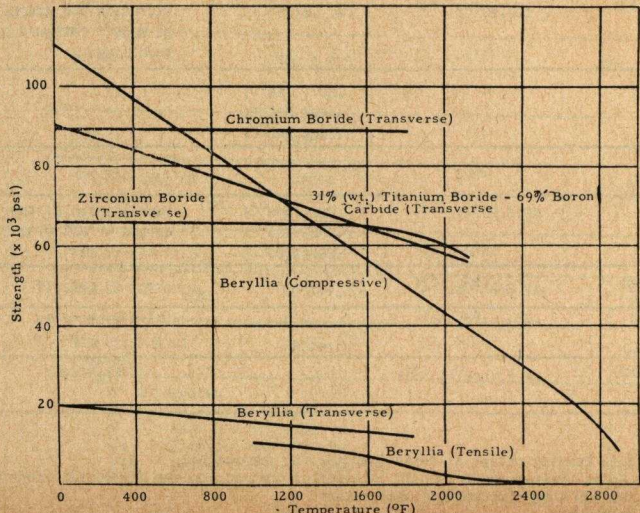
Material	$\Delta F^{\circ}_{298}*$	$\Delta H^{\circ}_{298}*$	$S^{\circ}_{298}\dagger$	$H^{\circ}_{1000}-H^{\circ}_{298}*$	$S^{\circ}_{1000}-S^{\circ}_{298}\dagger$	Material	$\Delta F^{\circ}_{298}*$	$\Delta H^{\circ}_{298}*$	$S^{\circ}_{298}\dagger$	$S^{\circ}_{1000}-H^{\circ}_{298}*$	$H^{\circ}_{1000}-S^{\circ}_{298}\dagger$
Al (c)	0.00	0.00	6.75	7.33 (l)	10.76 (l)	FeSiO ₃ (c)	-257	-276	22.0		
Al ₂ O ₃ (α)	-376.8	-399.1	12.2	18.7	31.1	Fe ₂ SiO ₄ (c)	-319.8	-343.7	35.4	29.3	49.2
Al ₂ O ₃ ·H ₂ O (c)	-435	-471	23.15			FeTiO ₃ (c)	-268.9	-288.5	25.3	20.4	34.3
Al ₂ O ₃ ·3H ₂ O	-547.9	-613.7	33.5			Pb (c)	0.00	0.00	15.49	5.96 (l)	10.2 (l)
Al ₂ SiO ₅ (sillimanite)	-615	-649	22.97	28.90	47.77	PbO (yellow)	-45.1	-52.1	16.6	9.3	15.4
Al ₂ SiO ₅ (andalusite)	-608	-642	22.28	29.60	49.72	Pb ₂ O ₃ (c)	-147.6	-175.6	50.5		
Al ₂ SiO ₅ (kyanite)	-610	-643	20.02	29.00	48.44	PbSiO ₃ (c)	-239.0	-258.8	28.7		
BaO (c)	-126.3	-133.4	16.8	9	14	Pb ₃ SiO ₄ (c)	-285.7	-312.7	43		
BaCO ₃ (c)	-272.2	-291.3	26.8	18.0	30.3	Mg (c)	0.00	0.00	7.77	6.96 (l)	10.4 (l)
Be (c)	0.00	0.00	2.28	3.80	6.17	MgO (c)	-136.1	-143.8	6.4	7.7	13.1
BeO (c)	-139.0	-146.0	3.37	7.01	11.40	Mg(OH) ₂ (c)	-199.3	-221.0	15.1		
Be ₃ N ₂ (c)	-121.4	-133.6	7.5	18	30	MgCO ₃ (c)	-246	-266	15.7		
B (c)	0.00	0.00	1.6	3.1	5.0	MgSiO ₃ (c)	-337.2	-357.9	16.2	13.6	30.8
B ₂ O ₃ (c)	-283.0	-302.0	12.9	22.9	35.4	Mg ₂ SiO ₄ (c)	-459.8	-488.2	22.7		
B ₂ O ₃ (glass)	-280.0	-297.6	18.8	18.6	29.7	MnO (c)	-86.8	-92.0	14.4	8.4	14.3
Ca (c)	0.00	0.00	9.95	5.2	8.7	MnO ₂ (c)	-111.4	-124.5	17.7	12	21
CaO (c)	-144.4	-151.9	9.5	9.0	14.8	Mn ₂ O ₃ (c)	-306.0	-331.4	35.5	28.6	48.2
Ca(OH) ₂ (c)	-219.3	-235.8	18.2			MnSiO ₃ (c)	-283.3	-302.5	21.3	19.1	32.0
Ca ₃ B ₂ O ₆ (c)	-777.1	-817.7	43.9	41.3	69.1	Ni (c)	0.00	0.00	7.20	5.2	8.8
Ca ₃ B ₂ O ₆ (c)	-618.6	-651.6	34.7	34.9	57.3	NiO (c)	-51.7	-58.4	9.24	9	14
CaB ₂ O ₄ (c)	-457.7	-483.3	25.1	24.4	40.4	N ₂ (g)	0.00	0.00	45.77	5.13	8.74
CaB ₄ O ₇ (c)	-752.4	-798.8	32.2	40.9	66.9	NH ₃ (g)	-3.98	-11.04	45.98	7.68	12.65
CaCO ₃ (c)	-269.8	-288.5	22.2	18.4	30.7	O ₂ (g)	0.00	0.00	49.00	5.43	9.19
CaF ₂ (c)	-277.7	-290.3	16.46	13.4	22.6	Pt (c)	0.00	0.00	10.0	4.66	7.93
Ca ₃ (PO ₄) ₂ (c)	-929.7	-986.2	57.6	50.6	85.7	Si (c)	0.00	0.00	4.47	4.15	6.8
CaSO ₄ (c)	-315.6	-342.4	25.5	22.9	37.1	SiO ₂ (quartz)	-192.4	-205.4	10.00	10.9	17.9
CaSO ₄ ·1/2H ₂ O (c)	-343.0	-376.5	31.2			SiO ₂ (cristobalite)	-192.1	-205.0	10.19	10.7	17.9
CaSO ₄ ·2H ₂ O (c)	-429.2	-483.1	46.4			SiO ₂ (tridymite)	-191.9	-204.8	10.36	10.6	17.7
CaSiO ₃ (c)	-358.2	-378.6	19.6	18.9	31.7	SiO ₂ (glass)	-190.9	-202.5	11.2	10.3	17.1
C (graphite)	0.00	0.00	1.36	2.81	4.47	SiC (c)	-26.1	-26.7	3.94	6.9	11.3
CO (g)	-32.81	-26.42	47.30	5.2	8.8	Ag (c)	0.00	0.00	10.21	4.59	7.78
CO ₂ (g)	-94.05	-94.26	51.00	8.0	13.3	Ag ₂ O (c)	-2.59	-7.31	29.09		
Cr (c)	0.00	0.00	5.68	4.95	8.27	SrO (c)	-133.8	-141.1	13.0	6.0	10.3
Cr ₂ O ₃ (c)	-250.2	-269.7	19.4	20.0	34.0	SrCO ₃ (c)	-271.9	-291.2	23.2		
Co (c)	0.00	0.00	6.8	5.2	8.7	SO ₂ (g)	-71.79	-70.96	59.40	8.2	13.7
CoO (c)	-51.0	-57.2	10.5			SnO ₂ (c)	-124.2	-138.8	12.5	12.2	20.4
Cu (c)	0.00	0.00	7.96	4.48	7.61	Ti (c)	0.00	0.00	7.24	4.84	8.1
Cu ₂ O (c)	-34.98	-39.84	24.1	13.0	22.1	TiO (c)	-120	-127	8.31	8.6	14.4
CuO (c)	-30.4	-37.1	10.4	8.68	14.6	TiO ₂ (c)	-149.4	-218.0	12.01	11.7	19.7
H ₂ (g)	0.00	0.00	31.21	4.94	8.49	Ti ₂ O ₃ (c)	-346	-367	18.83	22.74	38.02
H ₂ O (l)	-56.69	-68.32	16.72			Ti ₂ O ₅ (c)	-550	-584	30.92	35.23	61.52
H ₂ O (g)	-54.64	-57.80	45.11	6.21	10.49	TiC (c)	-56.5	-57.3	5.79	7.8	13.1
Fe (c)	0.00	0.00	6.49	5.30	9.42	TiN (c)	-73.5	-80.3	7.24	8.1	13.5
Fe _{0.95} O (wustite)	-58.4	-63.7	12.9	9.34	15.9	WC (c)	-3.4	-3.9	7.7		
Fe ₂ O ₃ (c)	-177.1	-196.5	21.5	23.5	39.1	Zn (c)	0.0	0.0	9.95	6.66	10.75
Fe ₂ O ₄ (c)	-252.4	-267.0	35.0	34.2	56.3	ZnO (c)	-76.1	-83.2	10.5	8.2	13.9
Fe(OH) ₂ (c)	-115.6	-135.8	19			ZnCO ₃ (c)	-174.8	-194.2	19.7		
Fe ₃ C (c)	4.7	5.8	25.7	19.6	33.7	ZnS (c)	-47.4	-48.5	13.8	8.82	14.98
FeCO ₃ (c)	-161	-276	22.0			Zr (c)	0.00	9.28	9.28	5.0	8.4
FeCr ₂ O ₄ (c)	-317.7	-341.9	34.9	28.0	46.9	ZrO ₂ (c)	-244.4	-258.2	12.12	11.5	19.5
						ZrN (c)	-75.3	-82.2	9.29		

* Kcal./gm. mole.
† Cal./gm. mole/°K.

In Table V are listed the standard molar heat and free energy of formation (from the elements in their standard state) at room temperature, ΔH°_{298} , ΔF°_{298} , of some materials employed in or of interest in ceramics. Also listed are the molar entropy at 298°K., S°_{298} , and the heat content and entropy increments on heating to 1000°K. from 298°K., $H^{\circ}_{1000} - H^{\circ}_{298}$ and $S^{\circ}_{1000} - S^{\circ}_{298}$. The data listed are from experimental measurements and include only materials for which relatively complete thermodynamic data are available. For many other materials heat capacity data, entropy values, or heat of formation values alone are available.

Ceramic Bulletin, Vol. 31, No. 10 (1952)

Strength Versus Temperature of Some Ceramic Materials



Ceramic Industry, April, 1956

Boron Nitride

Density		2.1 grams/cc	
Compressive Strength, psi		34000 *	
		45000 **	
Modulus of Rupture, psi	Temp.	**	*
	25° C.	15,880	7,280
	300° C.	15,140	7,030
	700° C.	3,840	1,900
	1000° C.	2,180	1,080
Modulus of Elasticity	Temp.	**	*
psi x 10 ⁶	25° C.	12.36	4.91
	300° C.	8.79	3.47
	700° C.	1.54	.51
	1000° C.	1.65	
Thermal Conductivity			
Parallel to Pressing	300° C.	.0362	
Direction C.G.S. Units	700° C.	.0318	
	1000° C.	.0295	
Coefficient of Thermal Expansion			
cm/cm/° C x 10 ⁻⁶	25° C.—350° C.	Perpendicular to Pressing Direction	Parallel to Pressing Direction
	25° C.—700° C.	0.59	10.15
	25° C.—1000° C.	0.89	8.06
		0.77	7.51
**Testing Force applied	parallel to direction of forming pressure.		
*Testing Force applied	perpendicular to direction of forming pressure.		
Boron Nitride Content	95—99%		
Oxidation in Air	Hours	Loss in Weight 700° C.	Mg/sq. cm. 1000° C.
	2	.014	.35
	10	.062	.85
	30	.138	4.8
	60	.235	10.0
Resistance to Chlorine	Hours	Loss in Weight 700° C.	Mg/sq. cm. 1000° C.
	3	.25	17.0
	20	.55	
	40		

Ceramic Industry, May, 1956

Silicon Nitride Bonded Silicon Carbide

Thermal Conductivity, at 1000° C., cal/sec, cm ² and °C/cm of thickness		.039
(BTU/hr., sq. ft. and °F/in. of thickness)		113.5
Compressive Strength at 20° C., psi		20,000
Tensile Strength at 20° C., psi		3000 to 3500
Density, gms/cc		2.6 to 2.8
Porosity		6% to 10%
Specific Heat at	0° C.	0.197
	1000° C.	0.297
	1400° C.	0.372
Moduli of Rupture, psi	25° C.	5,500
	700° C.	5,500
	1000° C.	7,000
	1500° C.	3,000
Moduli of Elasticity, psi	25° C.	17.0 x 10 ⁶
	700° C.	16.0 x 10 ⁶
	1000° C.	9.5 x 10 ⁶
Sustained load test at 50 psi and held for 100 hr. at 1500° C., % linear change cold		+0.25
Mean coefficients of thermal expansion	25° C.—200° C.	3.25 x 10 ⁻⁶
	25° C.—400° C.	3.76 x 10 ⁻⁶
	25° C.—600° C.	4.07 x 10 ⁻⁶
	25° C.—800° C.	4.29 x 10 ⁻⁶
	25° C.—1000° C.	4.47 x 10 ⁻⁶
	25° C.—1250° C.	4.69 x 10 ⁻⁶
Thermal shock resistance		Excellent

Ceramic Industry, May, 1956

Properties of Aluminum Oxide Base Materials For Cutting Tools

The composition, specific gravity, mechanical and thermal properties of representative materials are listed below.

Property	Sintered Aluminum Oxide	*Lodge Plugs Sintox	Degussit	Microelite Type TsM 332	Thermocorundum VNIA Sh Type 14
Composition	Al ₂ O ₃	....	97.5% Al ₂ O ₃ 2% Cr ₂ O ₃ 0.5% MgF ₂	Al ₂ O ₃ 1-3 micron grains, plus glass bond	Predominantly Al ₂ O ₃ (7-12 micron grain size)
Apparent sp gravity	3.80-3.87 (1)	3.65	3.97	3.85-3.95	3.75
Hardness	9 Mohs (1)	....	....	92-93Ra	86-92Ra
Bend strength (psi)	46,800 (1)	48,400	....	64,000	43,000
Tensile strength (psi)	37,000 (1)	10,800	....	....	....
Compressive strength (psi)	412,500 (1)	240,000	....	426,600	128,000-214,000
Modulus of elasticity (psix10 ⁶)	52.4 (1)	46.7	....	....	....
Specific heat (cal./gm)	0.21 (1)	0.175	....	....	....
	360° C	25° C	....	....	....
Lin. Coef. of thermal exp. per °C (x10 ⁻⁶)	9.0 (1)	6.2	....	....	....
	500° C-1000° C	0° C-300° C	....	....	....
Therm conductivity gm-cal/(sec) (sq.cm) (°C/cm)	.0164 (18)	....	....	....	0.0055
	800° C	....	....	....	....
Melting point	2050° C	....	....	....	....

*Properties are not necessarily the same as those of BSA Sintox tool material.

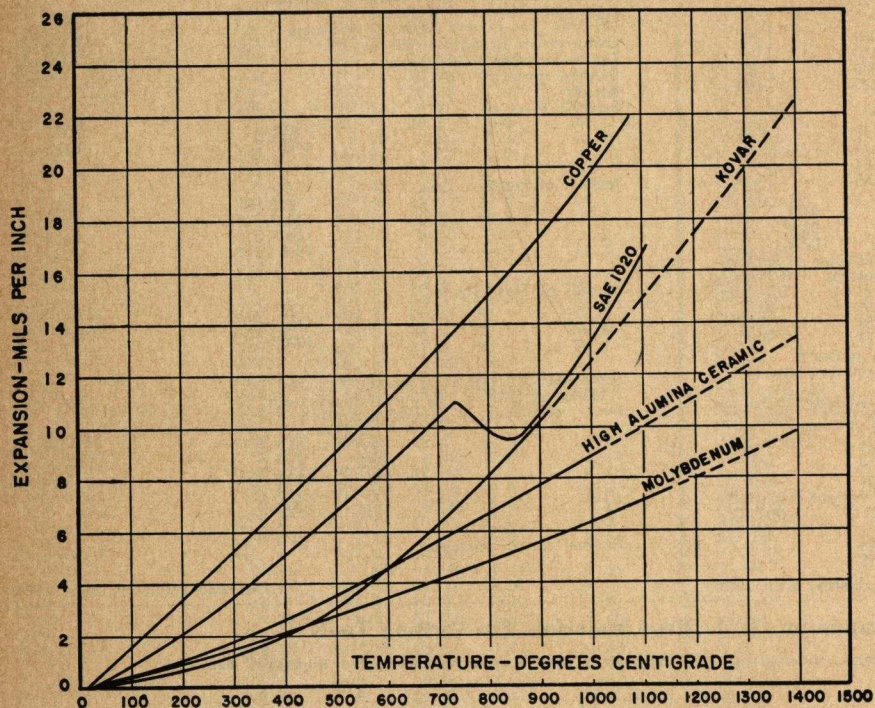
Courtesy, U. S. Dept. of Commerce, Watertown Arsenal, Report PB111759

Ferroelectric Oxide Compounds

FORMULA	NAME	CURIE TEMPERATURE	ROOM TEMPERATURE SYMMETRY AND STRUCTURE	REF.
BaTiO ₃	Barium titanate	120° C	tetragonal, perovskite	
PbTiO ₃	Lead titanate	490	" "	(1)
CdTiO ₃	Cadmium titanate	approx. -220	ilmenite	(2,3)
SrTiO ₃	Strontium titanate*	approx. -263	perovskite	(4)
(Pb, Ba) ZrO ₃	Modified lead zirconate			(5,6)
(Pb, Ba) SnO ₃	Modified lead stannate*	150		(7)
NaVO ₃	Sodium vanadate	approx. 330	perovskite	(8)
NaNbO ₃	Sodium niobate*	360	orthorhombic, perovskite	(10)
LiNbO ₃	Lithium niobate	?	ilmenite	(9)
KNbO ₃	Potassium niobate	420	orthorhombic, perovskite	(11)
PbNb ₂ O ₆	Lead niobate	570	orthorhombic	(12)
Cd ₂ Nb ₂ O ₇	Cadmium niobate	-103	pyrochlore	(13)
LiTaO ₃	Lithium tantalate	>350	ilmenite	(9)
NaTaO ₃	Sodium tantalate	approx. 475	ilmenite	(14)
KTaO ₃	Potassium tantalate	-260	ilmenite	(15)
RbTaO ₃	Rubidium tantalate	approx. 245		(16)
PbTa ₂ O ₆	Lead tantalate*	260		(7)
MoO ₃	Molybdc oxide*	>530 (?)	anatase	(16)
WO ₃	Tungstic oxide	approx. 750 (?)	rhenium oxide	(17)

Ceramic Industry, March, 1956

Thermal Expansion Curves for Various Materials Used in Ceramic-To-Metal Seals



Ceramic Industry, Dec., 1955

Coefficient of Thermal Expansion of Ceramic Materials

Material	Coefficient of Expansion $\alpha \times 10^{-7}$
β -Eucryptite	60 (to 700°C)
β -Spodumene	< 5
Fused Silica	5
Vycor Glass	8
Aluminum Titanate	< 10 (to 1000°C)
Zirconium Phosphate	< 10 (to 700°C)
Cordierite	20
Beryl	20
SnO ₂	35
Silicon Carbide	40
Mullite	40
Zircon	80-90
BeO, Al ₂ O ₃ , BeAl ₂ O ₄ , MgAl ₂ O ₄	110
Cubic ZrO ₂	140
MgO, CaO	140

Ceramic Industry, Dec., 1955

Properties of Cemented Carbides

	Cemented Tungsten Carbide *	Cemented Titanium Carbide **	Cemented Chromium Carbide
Hardness, Ra	85-93	83-93	88
Modulus of rupture, 1000 psi	200-385	125-250	100
Compressive strength, 1000 psi	520-800	550	—
Tensile strength, 1000 psi	to 190	to 140	—
Modulus of elasticity, 10 ⁶ psi	61-90	55	—
Density, grams per cc	11.9-15.1	5.8-6.5	7.0
Coefficient of thermal expansion to 1200°F.	2.5-4	4.5-5.8	6.0
per deg. F $\times 10^6$	4.5-7.2	8-10	10.8
to 1200°F, per deg. C $\times 10^6$	0.068-0.207	0.075-0.085	—
Thermal conductivity, cal. per deg. C	—	—	—
per cm per sec.	0.068-0.207	0.075-0.085	—
Electrical conductivity, % of copper	4.3-4.9	1.6-5.9	2.2
standard	—	—	—

*Kennametal

**Kentanium

John W. Graham, "Sintered Titanium Carbides Open New Industrial Horizons,"
The Iron Age, August 13, 1953.
Checked 1956

Zirconium Boride

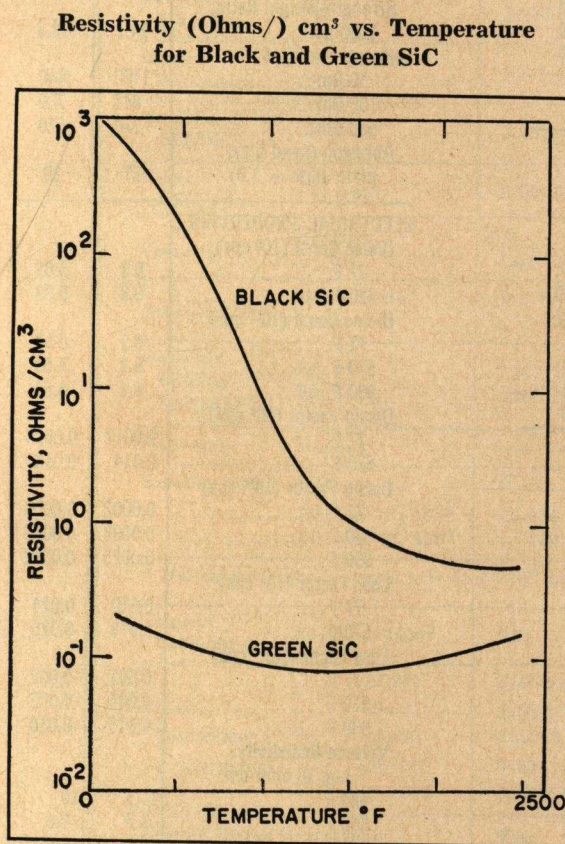
Density	5.2-5.4 grams/cc
Melting Point	5400° F.
Hardness	88-91 Rockwell A
Transverse Rupture Strength	33,000 psi 1800° F. 2200° F.
Oxidation Resistance	4 mg/cm ² 6 mg/cm ² 15 mg/cm ²
(Weight gain in still air at 2000° F.)	50 hours 100 hours 200 hours
(Materials not recommended beyond 200 hours at this temperature)	110° F.
Thermal Conductivity	15.9 BTU/ft. ² /hr./ft. ² /° F.
Expansion Coefficient	75°-1000° F. 75°-2200° F.
Specific Heat	0.115 BTU/lb./° F. 0.250 BTU/lb./° F.

Ceramic Industry, May, 1956

Physical Properties of Commercial TiC Cernets Kentanium Grades

Grade	Modulus of Rupture Strength, psi	Tensile Strength, psi	Modulus of Elasticity, in.-in. ⁻¹ , $\times 10^{-6}$	Coefficient of Thermal Expansion, in.-in. ⁻¹ , $\times 10^{-6}$	Thermal Conductivity, cal.-sec. ⁻¹ , cm. ⁻² , °C. ⁻¹
K151	190,000	—	—	—	—
K151A	175,000	—	4.28	—	—
K151B	150,000	95,000	—	—	—
K152A	150,000	—	—	5.4	0.0768
K152B	210,000	100,000	—	5.8	—
K153B	185,000	110,000	—	—	—
K161B	165,000	76,000	—	—	—
K162B	230,000	130,000	—	5.3	0.0724
K163B	210,000	130,000	—	5.4	—

Courtesy, High Temperature Technology, 1956



Ceramic Industry, May, 1957

Comparison of Properties of Block Talc with Phosphate-Bonded Talc, Hot-Pressed Synthetic Mica, and Phosphate-Bonded Synthetic Mica

Property	Natural Indian Block	Phosphate-Bonded Talc Dry Pressed*	Hot Pressed Synthetic Mica***	Synthetic Phosphate Bonded****
Specific gravity (gm/cc)	2.5	2.3-2.5	2.5-3.5	2.1-2.4
Unfired	2.8	2.4-2.6	2.5-3.5	2.0-2.5
Fired	2.3	3.5-9	0.05-10	3-10
Water absorption (%)	1.5-2.0	1.5-2.5	none	0.0-4
Linear firing shrinkage (%)	...	200-400	10,000	200-500
Flexural strength (psi)	9000	4,500-7,000	>35,000	5,000-9,000
Unfired	...	700-1,000	2+ - 4+	n.d.
Fired	30,000	25,000-40,000	2+ - 4+	n.d.
Compressive strength (psi)	1**	1-2**	5.8	2 - - 3+
Unfired	5.8	5.5	0.03-0.3%	4.7
Fired	0.03%	0.06%	0.03-0.3%	0.03-0.3%
Hardness (Mohs' scale)	0.13	0.08	0.05-0.3	0.4-0.6
Dielectric constant (1 mc)	0.7	0.13	0.8 - 1.0	1.1-2.0
Power factor (1 mc)	0.03%	0.06%	0.03-0.3%	0.03-0.3%
room temperature	0.13	0.08	0.05-0.3	0.4-0.6
room temperature	0.7	0.13	0.8 - 1.0	1.1-2.0
200°C	...	...	...	...
350°C	...	...	...	...

*All samples fired to 1,000°C on 12-hour schedule, data from Comeforo, Breedlove, Thurnauer, etc.
 **Thurnauer, "Phosphate-Bonded Talc: A Superior Bloc-Talc Substitute, Jour. Amer. Ceram. Soc., 37 (4) 191-95 (1954)
 ***Before firing
 ****Commercially available from Brush Beryllium Co., 4301 Perkins Ave., Cleveland, Ohio.
 *****Available from American Lava Corp., Chattanooga 5, Tenn.

Variation of Properties by use of Different Hot-Pressed Synthetic Mica Compositions

Property	Mica Composition	Property Value
Specific Gravity (g/cc)	KMg ₃ BSi ₃ O ₁₀ F ₂	2.75
	BaMg ₂ ½AlSi ₃ O ₁₀ F ₂	3.39
Hardness	KMg ₃ BSi ₃ O ₁₀ F ₂	49*
	BaMg ₂ ½AlSi ₃ O ₁₀ F ₂	260*
Thermal expansion (20-600°C)	KMg ₃ BSi ₃ O ₁₀ F ₂	12.6 × 10 ⁻⁶
	BaMg ₂ ½AlSi ₃ O ₁₀ F ₂	7.9 × 10 ⁻⁶
Poisson's ratio (stress of 10 tsi)	KMg ₃ BSi ₃ O ₁₀ F ₂	0.16
	KMg ₃ AlSi ₃ O ₁₀ F ₂	0.25
Power Factor (1 mc)	KMg ₃ BSi ₃ O ₁₀ F ₂	0.0007
	BaMg ₂ Al ₂ Si ₂ O ₁₀ F ₂	0.0003
Dielectric constant (1 mc)	KMg ₃ BSi ₃ O ₁₀ F ₂	5.9
	BaMg ₂ Al ₂ Si ₂ O ₁₀ F ₂	7.6

*Knoop number, 100 gm load used.

Ceramic Industry, Oct., 1956

Typical Properties of Some Ceramic Insulating Materials

Grade ^a →	Steatite (MgO • SiO ₂) L5A	Forsterite (2MgO • SiO ₂) L6B	Dense Cordierite (2MgO • 2Al ₂ O ₃ • 5SiO ₂) L2A	Zircon (ZrO ₂ • SiO ₂) L4A
PHYSICAL PROPERTIES				
Water Absorption, %.....	0-0.02	0-0.02	0-0.02	0-0.02
Specific Gravity.....	2.65	2.90	2.65	3.68
Softening Temperature, F.....	2600	2600	—	2800
Max Cont Svc Temp, F....	1800	1800	2200	2100
Coef of Ther Exp, per °F				
77-390 F.....	4.2 x 10 ⁻⁶	—	1.8 x 10 ⁻⁶	2.2 x 10 ⁻⁶
77-750 F.....	4.4 x 10 ⁻⁶	5.8 x 10 ⁻⁶	2.1 x 10 ⁻⁶	2.4 x 10 ⁻⁶
77-1100 F.....	4.6 x 10 ⁻⁶	5.9 x 10 ⁻⁶	2.3 x 10 ⁻⁶	2.6 x 10 ⁻⁶
Ther Cond (212 F), Btu/hr/sq ft/°F/ft.....	1.69	1.94	2.42	3.15
MECHANICAL PROPERTIES				
Flexural Strength, psi....	20,000	20,000	18,500	26,000
Tensile Strength, psi....	10,000	10,000	9,500	12,000
Compressive Strength, psi.....	85,000	85,000	90,000	95,000
Impact Strength (Charpy), in.-lb.....	4.6	4.0	4.4	5.6
ELECTRICAL PROPERTIES				
Dielectric Strength, v/mil.	240	240	230	230
Dielectric Constant				
1 Mc.....	6.1	6.2	6.2	8.8
100 Mc.....	6.0	6.1	—	8.6
Power Factor				
1 Mc.....	0.0013	0.0004	0.0093	0.0010
100 Mc.....	0.0010	0.0003	—	0.0012
Loss Factor				
1 Mc.....	0.007	0.002	0.0579	0.009
100 Mc.....	0.005	0.002	—	0.010
Te Value, F.....	1500	>1832	—	1590

^aMIL Spec JAN-I-10.

Class L Ceramics

Grade	Loss Factor
L-1.....	0.150
L-2.....	0.070
L-3.....	0.035
L-4.....	0.016
L-5.....	0.008
L-6.....	0.004

(MIL Spec JAN-I-10)

Properties of Two Polycrystalline Glasses^a
(Pyroceram)

Grade →	Code 9605	Code 9606
THERMAL PROPERTIES		
Softening Temp, F.....	2460	2280
Spec Ht (77 F), Btu/lb/°F.....	0.102	0.105
Ther Cond (77 F), Btu/hr/sq ft/°F/ft.....	2.4	1.7
Coef of Ther Exp (77-570 F), per °F.....	7.7 x 10 ⁻⁷	31.7 x 10 ⁻⁷
MECHANICAL PROPERTIES		
Mod of Elast, 10 ⁶ psi.....	19.8	17.8
Poisson's Ratio.....	—	0.24
Mod of Rupture, 1000 psi..	37	32
Strength-Weight Ratio, 1000 psi ^b	14.1	12.3
Knoop Hardness		
50 Gm.....	1100	940
100 Gm.....	843	789
500 Gm.....	720	570
Abrasion (sand blast; plate glass = 1.0).....	27	20
ELECTRICAL PROPERTIES		
Dielec Const (10 ⁶ cps)		
77 F.....	6.1	5.62
570 F.....	6.3	5.80
Dielec Const (10 ¹⁰ cps)		
77 F.....	6.1	5.53
570 F.....	6.1	5.53
930 F.....	6.1	5.54
Dissip Factor (10 ⁶ cps)		
77 F.....	0.0017	0.0024
570 F.....	0.014	0.013
Dissip Factor (10 ¹⁰ cps)		
77 F.....	0.0002	0.0003
570 F.....	0.0008	0.0006
930 F.....	0.0025	0.0018
Loss Factor (10 ⁶ cps)		
77 F.....	0.010	0.014
570 F.....	0.078	0.075
Loss Factor (10 ¹⁰ cps)		
77 F.....	0.001	0.002
570 F.....	0.005	0.003
930 F.....	0.015	0.010
Volume Resistivity, Log 10 ohm-cm		
480 F.....	10.1	10
660 F.....	8.7	8.6
OTHER PROPERTIES		
Specific Gravity (77 F)....	2.62	2.60
Water Absorption, %.....	0.00	0.00
Porosity (gas perm).....	Gas tight	Gas tight

^aTwo grades listed are those on which most data have been developed. Both are opaque.

Transparent grades are also available.

^bModulus of rupture ÷ specific gravity.

Source: Corning Glass Works.

PHYSICAL PROPERTIES OF HIGH ALUMINA CERAMICS

Property	Unit	85% Al ₂ O ₃ Vit. Body	95% Al ₂ O ₃ Vit. Body	99.5+Al ₂ O ₃ Vit. Body	99.5+Al ₂ O ₃ Porous Body
Tensile Strength	Psi	17-23000	25-35000	37500-38000	-----
Compressive Strength	Psi	140,-400,000	250,-400,000	427,000	10-125000
Flexural Strength	Psi	30-45000	45-50000	42700-47000	10-22000
Modulus of Elasticity	Psi	31-35 x 10 ⁶	39-43 x 10 ⁶	52 x 10 ⁶	-----
Impact Resistance	Inch-Pounds Charpy	5.8-7.0	6.2-7.6	-----	3.0
Specific Gravity	-----	3.40-3.53	3.61-3.75	3.7-3.97	2.4-3.40
Water Absorption	Per cent	0.00-.02	0.00	0.00	7-1.8
Porosity	Per cent	<1 Gas Tight*	<1 Gas Tight*	<1	7½ -----
Hardness	Moh's Scale Knoop	8.5-9 1450	9 1720	9 -----	----- -----
Maximum Working Temperature	°C °F	1300-1400 2200-2550	1600-1700 2910-3100	1950 3542	1400-1800 2550-3270
Pore Size	Microns	-----	-----	-----	2-3
Specific Heat	BTU per lb. BTU/hr/ft ² /100° BTU/hr/ft ² /800°	0.180 90-116 180	0.188-0.190 130-150 240	0.22 135 -----	----- 116 -----
* Helium mass spectrometer test on 0.010" sections					
Thermal Conductivity	°F/in. — 1600°	230	300	-----	-----
Thermal Coefficient of Expansion	25-200° 25-600 °C 25-700 25-800 25-1000	5.47-5.68 x 10 ⁻⁶ 6.55-6.96 7.6-7.9 7.33 7.67-7.89	5.7-6.67 x 10 ⁻⁶ 6.7-7.65 8.07 7.6 8.45-9.14	----- ----- 7.7 ----- 8.4	5.1 x 10 ⁻⁶ ----- ----- ----- -----
Thermal Shock Resistance		Fair	Good	Good	Good
Dielectric Strength	AC 25°C. 500°C. Volts/mil 1000°C.	205-350 ----- -----	250-400 100-120 20-30	380 ----- -----	50 ----- -----
Volume Resistivity	ohms/cm ² 25°C. 100°C. 200° 300°C. 400°C. 500°C. 600°C. 700°C. 800°C. 900°C.	1-3.6 x 10 ¹⁴ 2-7.5 x 10 ¹³ ----- 1-5.0 x 10 ¹⁰ ----- 1 x 10 ⁸ -7.5 x 10 ⁹ ----- 3-7.0 x 10 ⁶ ----- 4-5.0 x 10 ⁵	10 ¹⁶ 9.0 x 10 ¹⁴ 10 x 10 ¹³ 5.3 x 10 ¹² 10 x 10 ¹⁰ 1.2-4.5 x 10 ¹⁰ 10 ⁸ 6.0 x 10 ⁸ ----- -----	----- ----- ----- 1.2 x 10 ¹³ ----- 1.3 x 10 ¹¹ ----- 3.5 x 10 ⁸ ----- -----	10 ¹⁴ 8.5 x 10 ¹³ -1 x 10 ¹⁴ ----- 1 x 10 ¹⁰ -1.5 x 10 ¹¹ ----- 7.5 x 10 ⁷ -1.0 x 10 ⁹ ----- 3.6 x 10 ⁸ -3.0 x 10 ⁷ ----- 5.6 x 10 ⁵
T _e VALUE	°C	750-1000	800-1100	1100	835-1100

ELECTRICAL PROPERTIES OF HIGH ALUMINA CERAMICS

Property		Vit. 85% 25°C. 500°C.		Vit. 95% 25°C. 500°C.		Vit. 99.5+%	Porous 99.5+%
Dielectric Constant	60 cycle	8.4		9.2			
	1 x 10 ³ (1 kc)	7.65- 8.75	13.86	8.84- 10.51	13.3	10	
	1 x 10 ⁶ (1 mc)	7.4- 8.95	8.87	8.81 9.60	9.03		5.5
	1 x 10 ⁸	8.10- 8.95		8.80 9.60			5.3
	1 x 10 ⁹			8.60			
	3 x 10 ⁹	8.14		8.80			
	1 x 10 ¹⁰	8.08- 8.77	8.26	8.40- 9.36	9.03		7.07
Power Factor Tan δ	60 cycle	.0013- .0015		.0005			
	1 x 10 ³	.0002- .0014	0.580	.00007- .0006	1.1		
	1 x 10 ⁶	.0007- .0012	.024	.00035- .0035	.012		.0005
	1 x 10 ⁸	.0009		.00035- .0040	---		.0005
	1 x 10 ⁹	----		.0006			
	3 x 10 ⁹	.0014		.0010			
	1 x 10 ¹⁰	.0027	.0033	.0008- .0015	.0021		
Loss Factor	60 cycle	.011- .013-					
	1 x 10 ³	.00175- .0115	8.0	.0008- .0053	14.6		
	1 x 10 ⁶	.0018- .0078	.21	.0014 .0035	.108		.003
	1 x 10 ⁸	.006- .0074		.0031- .0040			.003
	1 x 10 ⁹	.0076		.0038			
	3 x 10 ⁹	.0114		.0088			
	1 x 10 ¹⁰	.013- .0218	.027	.0067 .0140	.019		.00075

From Ceramic Industry, January, 1958

Representative Semiconductors—Properties and Applications

Material	Band Separation (at 300 K), ev	Mobility (at 300 K), cm ² /v-sec		Melting Point, F	Application
		Electrons	Holes		
Germanium (Ge).....	0.72	3600	1900	1708	Rectifiers, transistors
Gallium Antimonide (GaSb).....	0.6 ^b	3000 ^b	1000 ^b	1295	
Silicon (Si).....	1.12	~ 2000	~ 500	2588	High temperature rectifiers and transistors; solar batteries; infrared optics; photocells
Indium Phosphide (InP).....	1.27	4000 ^b	650	1922	
Gallium Arsenide (GaAs).....	1.34	5000 ^b	300	2262	
Cadmium Telluride (CdTe).....	1.45	~ 1000	100 ^b	1913	
Aluminum Antimonide (AlSb).....	1.6	400 ^b	400	1922	
Cadmium Sulfide (CdS) ^a	2.4	250 ^b	—	—	Infrared detectors; filters
Gold-Doped Ge ^a	0.72	3600	1900	1716	
Mercury Telluride (HgTe) ^a	~ 0.06	~ 17,000	—	1238	
Indium Antimonide (InSb).....	0.16	75,000	800	972	Magnetoresistance devices; Hall effect de- vices; thermistors
Indium Arsenide (InAs).....	0.33	40,000	600 ^b	1727	
Lead Telluride (PbTe).....	0.3	2000	1100	1688	Infrared detectors
Lead Selenide (PbSe).....	0.26	1200	600	1976	
Lead Sulfide (PbS).....	0.4	800	400	2048	Thermoelectric devices
Bismuth Telluride (Bi ₂ Te ₃) ^a	0.16	570 ^b	400 ^b	1076	
Cadmium Antimonide (CdSb) ^a	0.5	—	400 ^b	852	

^aOne compound of a family of two or more related compounds.^bMinimum value.

Source: Willardson, R. K., and Shilliday, T. S., "The New Semiconductor Materials," MATERIALS IN DESIGN ENGINEERING, Mar '58, p 114.

Magnetic Properties of Some Commercial Ferromagnetic Ceramics^a

	Soft Ferrites					Rectangular Loop Ferrites	
	H	H-1	0-1	0-2	Q	S-4	S-5
Initial Permeability (1 mc/sec)....	850	550	800	1100	125	38	43
Max Permeability ^b	4300	3800	4250	3100	400	920	2600
Saturation Flux Density (B _s), gauss ^b	3400	2800	4250	4500	3300	1860	2100
Residual Magnetism, gauss ^b	1470	1500	1600	1600	1800	—	—
Coercive Force, oersted ^b	0.18	0.35	0.24	0.30	2.1	1.3	0.64
Temp Coef of Initial Perm, %/°F..	0.37	0.44	0.33	0.33	0.06 max	—	—
Curie Point, F.....	300	255	375	375	660	—	—
Volume Resistivity, ohm-cm.....	Medium	Medium	Low	Low	High	—	—
Loss Factor (1/M ₀ Q)							
1 mcs/sec.....	0.00030	0.0004	—	—	0.000020	—	—
5 mcs/sec.....	0.00155	0.0010	0.000015 ^c	0.000011 ^c	0.000050	—	—
Retentivity (B _r), gauss.....	—	—	—	—	—	1630	1950
B _r /B _s	—	—	—	—	—	0.88	0.93

^aMaterials are proprietary—trademarked Ferramic.^bMeasurements made on d.c. ballistic galvanometer; H_{max} = 25 oersteds for soft materials; H_{max} = 5 oersteds for rectangular loop materials.^cAt 50 kc per sec.

Source: General Ceramics Corp.

Power and Power Transmission

Selection Chart of Slow-Speed Motor Application

CLASS I. Uniform load—8 to 10 hours per day—continuous operation, constant torque load. Infrequent starting.

CLASS II. Moderate shock load—8 to 10 hours per day, or uniform load 24 hours per day.

CLASS III. Heavy shock load—24 hours per day.

CLASS			CLASS			CLASS		
APPLICATION	8-10 Hour Serv.	24 Hour Serv.	APPLICATION	8-10 Hour Serv.	24 Hour Serv.	APPLICATION	8-10 Hour Serv.	24 Hour Serv.
AGITATORS	I	I	CONVEYORS			Auxiliary drives (Feed, Traverse, etc.)	I	II
Variable density			(Heavy duty or dual drive— not uniformly fed)					
FLOWERS			Apron	II	II	METAL MILLS		
(centrifugal)	I	II	Assembly	II	II	Forming machines	III	III
CAR DUMPERS	II	III	Belt	II	II	Pinch, dryer and scrubber rolls (reversing)	*	*
CAR PULLERS	II	III	Bucket	II	II	Slitters	III	III
CLASSIFIERS	II	II	Flight	II	II	MILLS (ROTARY TYPE)		
CLAY WORKING MACHINERY			Oven	II	II	Ball	III	III
Brick press	III	III	Screw	III	III	Cement kilns	...	III
Briquett machine	III	III	Reciprocating	III	III	Dryers and Coolers	...	II
Clay working machinery	II	II	Shaker	III	III	Kilns	II	III
Pug mill	II	II	CRANES & HOISTS			Pebble	II	III
Rotary kiln	II	II	Main hoists—medium duty	II	II	Rod	III	III
COMPRESSORS			—heavy duty	III	III	Tumbling barrels	III	III
Centrifugal	I	II	Skip hoists	II	II	MIXERS		
Reciprocating multi-cylinder— adequately flywheeled	II	III	Travel motion	II	II	Concrete mixers—continuous	II	II
within 3% cyclic variation)	*	*	Trolley motion	II	II	Concrete mixers—intermittent	I	...
Reciprocating, single cylinder			ELEVATORS			Constant density	I	II
CONVEYORS			(Conveyor type—same as conveyors)			PUMPS		
(Uniformly loaded or fed)			Freight	II	II	Centrifugal—with surge tanks or equivalent	I	II
Apron	I	II	Passenger	III	III	Centrifugal—without surge tanks	II	II
Assembly	I	II	FANS			Gear and rotary—constant density fluid	I	II
Belt	I	II	Centrifugal	I	II	Gear and rotary—variable density fluid	II	II
Flight	I	II	Large (mine, etc.)	II	III	Proportioning pumps	II	III
Oven	I	II	Light small diameter	I	II	Reciprocating—with open discharge	I	II
Screw	I	II	HAMMER MILLS	III	III	Reciprocating—multi-cylinder, double acting	II	II
			HOISTS—See CRANES			Reciprocating—single cylinder	*	*
			LINE SHAFTS			SCREENS		
			Driving processing equipment	II	II	Rotary—stone or gravel	II	II
			Other line shafts	I	II			
			MACHINE TOOLS					
			Punch press (gear connected to load) and shears	III	III			
			Notching press (belt driven)	I	II			

Checked 1952 by Sterling Electric Motors, Inc.

Induction Motor Requirements for Various Machines

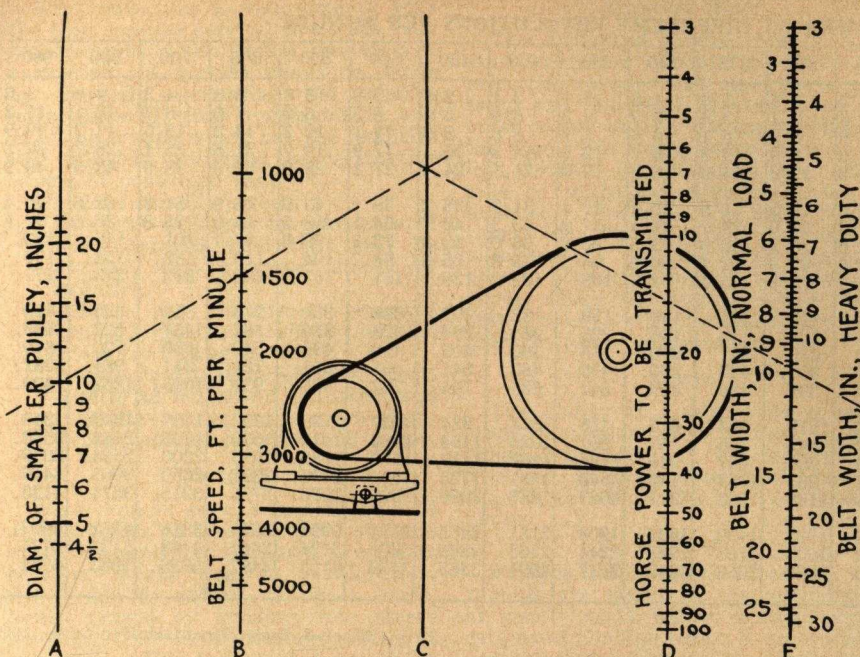
REQUIREMENTS OF DRIVEN MACHINE				AVAILABLE MOTORS		
Speed Classification	Starting Load	Examples	Description	*NEMA Classifica- tion	G-E Type	Remarks
Single-speed (Constant- speed)	Normal	Fans, centrifugal pumps, centrifugal compressors.	Squirrel-cage, nor- mal-starting- torque, low-slip.	Designs A and B	Type K	See Table II for locked-rotor torque.
	High breakaway	Reciprocating pumps, reciprocating com- pressors, loaded conveyors.	Squirrel-cage, high- starting-torque, low-slip.	Design C	Type KG	See Table III for locked-rotor torque.
			Squirrel-cage, high- starting-torque, high-slip.	Design D	Type KR	Locked-rotor torque 275 per cent of full-load torque.
			Squirrel-cage, nor- mal-starting- torque, low-slip.	Designs A and B	Type K	Advantageous where torque re- quirements increase with ac- celerating speed. See Table II for locked-rotor torque.
	High inertia	Large flywheel loads.	Squirrel-cage, high- starting-torque, high-slip.	Design D	Type KR	Used for fluctuating fly-wheel loads.
			Wound-rotor.	.....	Type M	Smooth acceleration possible by use of starting rheostats in secondary circuit.
	Rapid- reversing		Squirrel-cage, high- starting-torque, high-slip.	Design D	Type KR	High-slip characteristics essen- tial in rapid reversing service.
Multi-speed (Constant- speed)	Normal	Stokers, conveyors.	Squirrel-cage, nor- mal-starting- torque, low-slip.	.....	Type K	Available with two, three, or four speeds in constant-torque, con- stant-hp, and variable torque designs.
Adjustable- speed (varying- speed)	Normal or high	Conveyors, rotary kilns.	Wound-rotor.	.....	Type M	Has constant-speed characteris- tics at full speed. Best speed range 2:1.
Adjustable- speed (Constant- speed)	Normal or high	Conveyors, rotary kilns, reels, winches.	A-c commutator motor.	.....	Type ACA	Normal speed range 3:1. Ranges of 6:1 and 20:1 available.
			Packaged adjustable- speed drives.	.....	Speed Variator	M-g set conversion. Wide speed ranges. Automatic controls.
					Thy-mo- trol	Electronic conversion. Wide speed ranges. Automatic con- trols.

* National Electrical Manufacturers' Association.

Courtesy, General Electric Co., 1952
Checked 1956

Short Center Belt Chart

(Pulley ratios up to 6 to 1; 2-ply quality belts)



To use the chart, run a straight line through the diameter of the smaller pulley, column A, and the belt speed in ft. per min., column B, and locate the intersection in column C. Then from that point of intersection run a second straight line through the horsepower to be transmitted, column D. The intersection with column E then gives the proper belt width to use. For example, the two dotted lines drawn

across the chart show that where the smaller pulley has a diameter of 10 inches, the belt speed being 1,500 ft. per min., and 15 h.p. are to be transmitted, a belt 10 inches wide will be required if the load is normal. Column E also shows that if it is a "heavy duty" load the belt should be a little over 11 inches wide. In other words, column E takes care of both normal loads and heavy duty loads.

Checked by W. F. Schaphorst, 1952

Correction for Arc of Contact

The loss in arc of contact from 180° for different sheave diameters and center distances can be determined in the following manner. (All dimensions given in inches.):

$$\text{Arc Loss} = \frac{(\text{Dia. Large Sheave} - \text{Dia. Small Sheave} \times 60)}{\text{Center Distance}}$$

Correction Factors for loss in arc of contact in degrees are:

Loss in Arc of Contact	Correction Factor
0	1.00
3	.99
6	.99
10	.98
13	.97
16	.96
20	.95
23	.94
26	.93
30	.92
33	.91
36	.90
40	.89
43	.88
46	.87
50	.86
53	.85
56	.84
60	.82
62	.82
65	.81

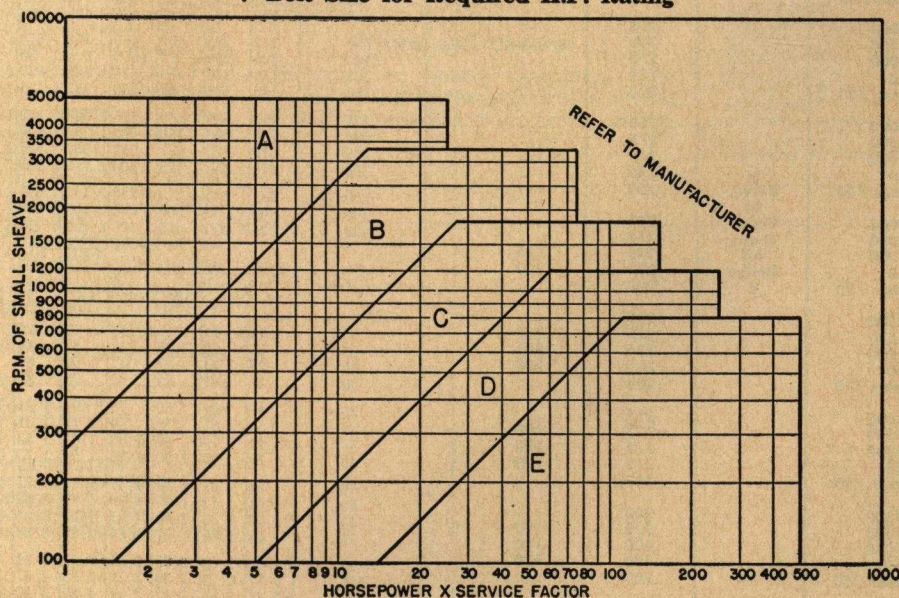
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Types of Air-Hydraulic Control Valves

- Manually Operated
- Toggle Operated (air only)
- Foot Operated
- Cam Operated
- Air Cylinder operated (air only)
- Electric Solenoid operated
- Bleeder operated (air only)
- Pilot Pressure (air only)

Checked 1956

V-Belt Size for Required H.P. Rating



To Use the Above Table Proceed as Follows: 1. Multiply the horsepower to be transmitted by the drive by the proper service factor from table on para. 538 to obtain the design horsepower. 2. Above the design horsepower (horsepower multiplied by the service factor) and to the right of the R.P.M. of the small sheave, find the belt cross section recommended for the drive. 3. When this point falls near the dividing line it is always desirable to investigate the possibility of both belt cross sections. Example: For 25 H.P. at 1750 R.P.M. investigate both B and C section belts. Special circumstances such as space limitations may lead to the choice of a belt cross section different from that indicated by the table.

Multiple V-Belt Drive & Mechanical Power Transmission Assn.—1952
Checked 1956

Horsepower of Main Shafts at Different Speeds

Dia. Shaft	HORSEPOWER AT DIFFERENT REVOLUTIONS PER MINUTE																	
	100	125	150	175	200	225	250	275	300	350	400	450	500	550	600	700	800	900
1 1/16	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.6	1.8	2.1	2.4	2.7	3.0	3.3	3.6	4.3	4.9	5.5
1 1/8	1.2	1.5	1.8	2.1	2.5	2.8	3.1	3.4	3.7	4.3	5.0	5.6	6.2	6.8	7.5	8.7	10.1	11.2
1 1/4	2.2	2.7	3.3	3.8	4.4	4.9	5.5	6.1	6.6	7.7	8.8	9.9	11.1	12.2	13.3	15.5	17.7	19.9
1 1/2	3.5	4.4	5.3	6.2	7.1	8.0	8.9	9.8	10.7	12.5	14.3	16.1	17.9	19.7	21.5	25.1	28.7	32.3
1 5/8	5.4	6.7	8.1	9.5	10.8	12.2	13.5	14.9	16.3	19.0	21.7	24.4	27.1	29.9	32.6	38.0	43.5	48.9
2 1/16	7.8	9.7	11.7	13.7	15.6	17.6	19.5	21.5	23.4	27.4	31.3	35.2	39.1	43.0	46.9	54.8	62.6	70.4
2 1/8	10.8	13.5	16.2	18.9	21.6	24.3	27.0	29.7	32.4	37.9	43.3	48.7	54.1	59.5	64.9	75.8	86.6	97.4
2 1/4	14.5	18.1	21.7	25.4	29.0	32.6	36.2	39.9	43.5	50.8	58.0	65.3	72.5	79.8	87.1	101	116	130
2 1/2	18.9	23.6	28.4	33.1	37.9	42.6	47.3	52.1	56.8	66.3	75.8	85.3	94.7	104	113	132	151	170
3 1/16	30.3	37.9	45.5	53.1	60.7	68.3	75.9	83.5	91.1	106	121	136	151	167	182	212	243	273
3 1/8	45.6	57.0	68.4	79.9	91.3	102	114	125	136	159	182	205	228	251	273	319	365	410
3 1/4	65.3	81.6	98.0	114	130	147	163	179	196	228	261	294	326	359	392	457	522	588
3 1/2	90.0	112	135	157	180	202	225	247	270	315	360	405	450	495	540	630	720	810
4 1/16	120	150	180	210	240	270	300	330	360	420	480	541	601	661	721	841	961	1082
4 1/8	156	195	234	273	313	352	391	430	469	547	626	704	782	861	939	1095	1252	1409
6 1/2	205	256	308	359	410	462	513	564	616	718	821	924	1027	1129	1232	1437	1643	1848
7	256	320	384	448	513	577	641	705	769	897	1026	1154	1282	1410	1539	1795	2052	2308
7 1/2	315	394	473	552	631	709	788	867	946	1104	1262	1419	1577	1735	1893	2208	2524	2839
8	382	478	574	670	765	861	957	1053	1148	1340	1531	1723	1914	2106	2297	2680	3063	3446
8 1/2	459	574	688	803	918	1033	1148	1263	1377	1607	1837	2066	2296	2526	2755	3215	3674	4133
9	545	681	817	954	1090	1226	1363	1499	1635	1908	2181	2453	2726	2998	3271	3816	4362	4907
9 1/2	641	801	961	1122	1282	1442	1603	1763	1923	2244	2565	2885	3206	3526	3847	4488	5130	5771
10	747	934	1121	1308	1495	1682	1869	2056	2243	2617	2991	3365	3739	4113	4487	5235	5983	6731

Checked, Dodge Manufacturing Corp., 1952

Break-Down Torque of Polyphase Squirrel-Cage Induction Motors with Continuous Ratings

Rating Hp	Synchronous Speed—Rpm (60 and 50 Cycles)	Breakdown Torque (Per Cent of Full-load Torque)		
		Design A	Design B	Design C
1/2	900-750		250	...
	Lower than 750		200	...
1/4	1200-1000		275	...
	900-750		250	...
1	1800-1500		300	...
	1200-1000		275	...
1 1/2	3600-3000		275	...
	1800-1500		300	...
2	3600-3000		250	...
	1800-1500		275	...
3	3600-3000		250	...
	1800-1500		275	...
5	3600-3000		225	...
	1800-1500		250	...
7 1/2	3600-3000		215	...
	1800-1500		215	...
10	3600-3000		200	...
	1800-1500		200	...
15-25 & larger	All Speeds		200	190
	All Speeds		200	190

Design A, B, and C—The break-down torque of Design A, B, and C, 60- and 50-cycle, polyphase squirrel-cage motors, with rated voltage and frequency applied, shall be in accordance with the following values which are expressed in per cent of full-load torque and which represent the upper limit of the range of application for these motors.

Courtesy, General Electric Co., 1953

Hp. Required to Raise Water to Different Heights

Gallons per Min.	FEET ELEVATION											
	5	10	15	20	25	30	35	40	45	50	60	
5	.006	.012	.019	.025	.031	.037	.044	.05	.06	.06	.07	
10	.012	.025	.037	.050	.062	.075	.087	.10	.11	.12	.15	
15	.019	.037	.056	.075	.094	.112	.131	.15	.17	.19	.22	
20	.025	.050	.075	.100	.125	.150	.175	.20	.22	.25	.30	
25	.031	.062	.093	.125	.156	.187	.219	.25	.28	.31	.37	
30	.037	.075	.112	.150	.187	.225	.262	.30	.34	.37	.45	
35	.043	.087	.131	.175	.219	.262	.306	.35	.39	.44	.52	
40	.050	.100	.150	.200	.250	.300	.350	.40	.45	.50	.60	
45	.056	.112	.168	.225	.281	.337	.394	.45	.51	.56	.67	
50	.062	.125	.187	.250	.312	.375	.437	.50	.56	.62	.75	
60	.075	.150	.225	.300	.375	.450	.525	.60	.67	.75	.90	
75	.093	.187	.281	.375	.469	.562	.656	.75	.84	.94	1.12	
90	.112	.225	.337	.450	.562	.675	.787	.90	1.01	1.12	1.35	
100	.125	.250	.375	.500	.625	.750	.875	1.00	1.12	1.25	1.50	
125	.156	.312	.469	.625	.781	.937	1.094	1.25	1.41	1.56	1.87	
150	.187	.375	.562	.750	.937	1.125	1.312	1.50	1.69	1.87	2.25	
175	.219	.437	.656	.875	1.093	1.312	1.531	1.75	1.97	2.19	2.62	
200	.250	.500	.750	1.000	1.250	1.500	1.750	2.00	2.25	2.50	3.00	
250	.312	.625	.937	1.250	1.562	1.875	2.187	2.50	2.81	3.12	3.75	
300	.375	.750	1.125	1.500	1.875	2.250	2.625	3.00	3.37	3.75	4.50	
350	.437	.875	1.312	1.750	2.187	2.625	3.062	3.50	3.94	4.37	5.25	
400	.500	1.000	1.500	2.000	2.500	3.000	3.500	4.00	4.50	5.00	6.00	
500	.625	1.250	1.875	2.500	3.125	3.750	4.375	5.00	5.62	6.25	7.50	

Gallons per Min.	FEET ELEVATION											
	75	90	100	125	150	175	200	250	300	350	400	
5	.09	.11	.12	.16	.19	.22	.25	.31	.37	.44	.50	
10	.19	.22	.25	.31	.37	.44	.50	.62	.75	.87	1.00	
15	.28	.34	.37	.47	.56	.66	.75	.94	1.12	1.31	1.50	
20	.37	.45	.50	.62	.75	.87	1.00	1.25	1.50	1.75	2.00	
25	.47	.56	.62	.78	.94	1.09	1.25	1.56	1.87	2.19	2.50	
30	.56	.67	.75	.94	1.12	1.31	1.50	1.87	2.25	2.62	3.00	
35	.66	.79	.87	1.08	1.31	1.53	1.75	2.19	2.62	3.06	3.50	
40	.75	.90	1.00	1.25	1.50	1.75	2.00	2.50	3.00	3.50	4.00	
45	.84	1.01	1.12	1.41	1.69	1.97	2.25	2.81	3.37	3.94	4.50	
50	.94	1.12	1.25	1.56	1.87	2.19	2.50	3.12	3.75	4.37	5.00	
60	1.12	1.35	1.50	1.87	2.25	2.62	3.00	3.75	4.50	5.25	6.00	
75	1.40	1.69	1.87	2.34	2.81	3.28	3.75	4.69	5.62	6.56	7.50	
90	1.68	2.02	2.25	2.81	3.37	3.94	4.50	5.62	6.75	7.87	9.00	
100	1.87	2.25	2.50	3.12	3.75	4.37	5.00	6.25	7.50	8.75	10.00	
125	2.34	2.81	3.12	3.91	4.69	5.47	6.25	7.81	9.37	10.94	12.50	
150	2.81	3.37	3.75	4.69	5.62	6.56	7.50	9.37	11.25	13.12	15.00	
175	3.28	3.94	4.37	5.47	6.56	7.66	8.75	10.94	13.12	15.31	17.50	
200	3.75	4.50	5.00	6.25	7.50	8.75	10.00	12.50	15.00	17.50	20.00	
250	4.69	5.62	6.25	7.81	9.37	10.94	12.50	15.72	18.75	21.87	25.00	
300	5.62	6.75	7.50	9.37	11.25	13.12	15.00	18.75	22.50	26.25	30.00	
350	6.56	7.87	8.75	10.94	13.12	15.31	17.50	21.87	26.25	30.62	35.00	
400	7.50	9.00	10.00	12.50	15.00	17.50	20.00	25.00	30.00	35.00	40.00	
500	9.37	11.25	12.50	15.62	18.75	21.87	25.00	31.25	37.50	43.75	50.00	

Checked 1956

Selecting Wire Rope

When selecting a wire rope to give the best possible service, there are four requirements which should receive consideration. A proper choice is made by correctly estimating the relative importance of these requirements and selecting a rope which has the qualities best suited to withstand the destructive effects of continued use.

The rope should possess:

Strength sufficient to take care of the maximum load that may be applied, with a proper factor of safety.

Ability to withstand repeated bending without failure of the wires from fatigue.

Ability to withstand abrasive wear. Ability to withstand distortion and crushing—or, to put it more plainly, the ability to withstand abuse.

Strength

Wire rope in service is subjected to several kinds of stresses. The stresses most frequently encountered are direct tension, stress due to acceleration, stress due to sudden or shock loads, stress caused by bending, and stress resulting from several forces acting at one time. For the most part, these stresses can be converted into terms of simple tension, and a rope of approximately the correct strength can be chosen. As the strength of a wire rope is determined by its size, grade and construction, all three of these factors should be considered.

Working Loads and Safety Factors

The safety factor is the ratio of the strength of the rope to the working load. Thus, a wire rope with a strength of 10,000 pounds and a total working load of 2,000 pounds would be operating with a safety factor of five.

It is not possible to establish a uniform safety factor for each type of rope-using equipment, as this factor can safely vary with conditions on individual units of equipment. The proper safety factor depends not only on the loads applied, but also on the speed of operation, the type of fittings used for securing the rope ends, the acceleration and deceleration, the length of rope, the number, size and location of sheaves and drums, the factors causing abrasion and corrosion, the facilities for inspection, and the danger to life and property should a rope fail.

The following table of minimum safety factors is submitted only as a guide. These have been established by experience as the minimum safety factors required for safety and economy on the average installation. Larger safety

factors are desirable, as they represent greater safety and, in most cases, increased economy.

Abrasive Wear

The ability of a wire rope to withstand abrasion is determined by the size, the carbon and manganese content, and the heat treatment of the outer wires; and by the construction of the rope. The larger outer wires of the less flexible constructions are better able to withstand abrasion than the finer outer wires of the more flexible ropes. The higher carbon and manganese content and the heat treatment used in producing wire for the stronger ropes, make the higher grade ropes better able to withstand abrasive wear than the lower grade ropes.

Abuse

The ability of a wire rope to withstand distortion and crushing is governed principally by its construction. The use of large outer wires and of wire centers increases the resistance to abuse.

Fatigue

Fatigue failure of the wires of a wire rope is the result of the propagation of small cracks under repeated applications of bending loads. It occurs when ropes operate over comparatively small sheaves or drums. The repeated bending and subsequent straightening of the individual wires as the rope passes over small sheaves or drums cause fatigue. The effect of fatigue on a wire can be illustrated by bending it back and forth until it breaks.

The best method of preventing early fatigue in wire ropes is to employ sheaves and drums of adequate size for the type of rope to be used. The more flexible constructions of wire rope have greater resistance to fatigue, as increased flexibility in a given grade of rope is obtained by the use of smaller wires. A 6x37 rope, for example, is more flexible than a 6x19 rope of the same size and grade, and may therefore be safely used with smaller sheaves or drums.

Drums and Sheaves

In order to obtain maximum wire rope service, sheaves and drums should be carefully examined for free running,

for adequate diameter and for suitable width of grooves. It is advisable to design sheave and drum equipment so that the tread diameters are approximately as follows:

RECOMMENDED TREAD DIAMETERS

Type of Wire Rope	Drums and Sheaves
6x7	72 Times rope diameter
6x17 Type L	51 Times rope diameter
6x19 Seale Patent	51 Times rope diameter
18x 7 Non-Spinning	51 Times rope diameter
6x21 Type M	45 Times rope diameter
6x25 Type B	45 Times rope diameter
6x30 Type G	45 Times rope diameter
6x19 Type N	39 Times rope diameter
8x19 Seale Patent	39 Times rope diameter
6x29 Type P	34 Times rope diameter
6x33 Type R	31 Times rope diameter
6x41 Type T	31 Times rope diameter
8x19 Type N	31 Times rope diameter
6x37 Type S	27 Times rope diameter

Service conditions often allow—and sometimes require for economical service—the use of even larger diameters. On some of the larger hoisting installations, for example, sheave diameters for use with 6x7 ropes are established at 96 times the rope diameter, and those for use with 6x19 ropes at 90 times the rope diameter. It should be understood that sheave diameters larger than those listed will give longer rope life.

It is also true that for certain types of service, ratios smaller than the foregoing can be employed with reasonable economy, but, even where conditions are most favorable, it is never advisable to permit the use of sheaves and drums smaller than those listed in the following table:

MINIMUM TREAD DIAMETERS

Type of Wire Rope	Drums and Sheaves
6x7	42 Times rope diameter
6x17 Type L	34 Times rope diameter
6x19 Seale Patent	34 Times rope diameter
18x 7 Non-Spinning	34 Times rope diameter
6x21 Type M	30 Times rope diameter
6x25 Type B	30 Times rope diameter
6x30 Type G	30 Times rope diameter
6x19 Type N	23 Times rope diameter
8x19 Seale Patent	26 Times rope diameter
6x29 Type P	23 Times rope diameter
6x33 Type R	21 Times rope diameter
6x41 Type T	21 Times rope diameter
8x19 Type N	21 Times rope diameter
6x37 Type S	18 Times rope diameter

Checked by American Steel & Wire Co., 1952

Type of Service	Minimum Safety Factor
Track Cables.....	3.2
Guy.....	3.5
Mine Shafts.....	8.0 for depths to 500 ft. 7.0 for depths 500-1000 ft. 6.0 for depths 1000-2000 ft. 5.0 for depths 2000-3000 ft. 4.0 for depths 3000 ft. and more
Misc. Hoisting Equipment.....	5.0
Haulage Ropes....	6.0
Overhead & Gantry Cranes.....	6.0
Jib, Pillar Cranes	6.0
Derricks.....	6.0
Small Electric and Air Hoists.....	7.0
Hot Ladle Cranes	8.0
Slings.....	8.0

Wire Sizes for Distance Voltage Drops

Two Per Cent Loss on 110 Volts
Wire sizes given are B. & S. American Wire Gage.

Capacity Amperes	Distance in Feet to Center of Distribution																		Capacity Amperes
	20	30	40	50	60	70	80	90	100	120	140	160	180	200	240	280	320	360	
1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	16	15	15	14	1
1.5	..	..	..	..	..	..	..	..	..	..	..	16	15	15	14	14	13	12	1.5
2	..	..	..	..	..	..	..	..	..	16	15	15	14	14	13	12	12	11	2
3	..	..	..	..	..	..	16	15	15	14	14	13	12	12	11	11	10	9	3
4	..	..	..	..	16	15	15	14	14	13	12	12	11	11	10	9	8	7	4
5	..	..	16	15	14	14	14	13	13	12	11	11	10	9	8	7	6	5	5
6	..	16	15	14	14	13	12	12	12	11	11	10	9	8	7	6	5	4	6
7	..	16	15	14	13	12	12	12	11	11	10	9	8	7	6	5	4	3	7
8	..	16	15	14	13	12	12	11	11	10	9	8	7	6	5	4	3	2	8
9	..	15	14	13	12	12	11	11	10	9	8	7	6	5	4	3	2	1	9
10	16	15	14	13	12	11	11	10	9	8	7	6	5	4	3	2	1	0	10
12	16	14	13	12	11	11	10	9	8	7	6	5	4	3	2	1	0	0	12
14	15	14	12	11	11	10	9	8	7	6	5	4	3	2	1	0	0	0	14
16	15	13	12	11	10	9	8	7	6	5	4	3	2	1	0	0	0	0	16
18	14	12	11	10	9	8	7	6	5	4	3	2	1	0	0	0	0	0	18
20	14	12	11	10	9	8	7	6	5	4	3	2	1	0	0	0	0	0	20
25	13	11	10	9	8	7	6	5	4	3	2	1	0	0	0	0	0	0	25
30	12	10	9	8	7	6	5	4	3	2	1	0	0	0	0	0	0	0	30
35	11	10	8	7	6	5	4	3	2	1	0	0	0	0	0	0	0	0	35
40	11	9	8	7	6	5	4	3	2	1	0	0	0	0	0	0	0	0	40
45	10	9	7	6	5	4	3	2	1	0	0	0	0	0	0	0	0	0	45
50	10	8	7	6	5	4	3	2	1	0	0	0	0	0	0	0	0	0	50
60	9	7	6	5	4	3	2	1	0	0	0	0	0	0	0	0	0	0	60
70	8	7	5	4	3	2	2	1	0	0	0	0	0	0	0	0	0	0	70
80	8	6	5	4	3	2	2	1	0	0	0	0	0	0	0	0	0	0	80
90	7	6	4	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	90
100	7	5	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	100
120	6	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	120

Checked by Westinghouse Electric Corp., 1952

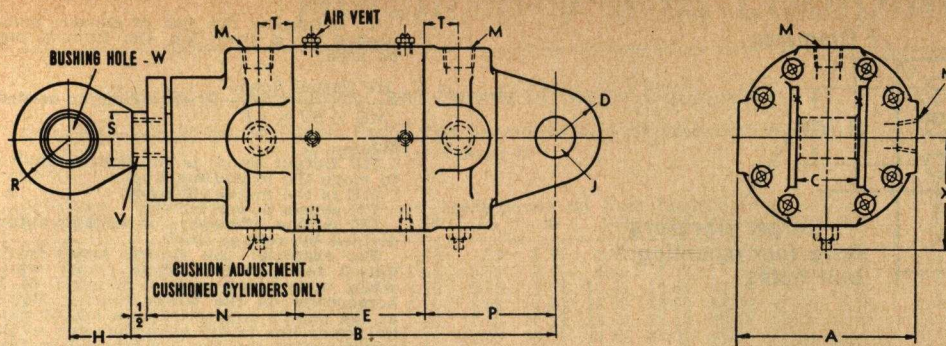
Electrical Formulae

Amperes, Horsepower, Kilowatts and KVA

Required Amperes when H.P. is known Amperes when Kilowatts are known Amperes when KVA is known Kilowatts KVA Horsepower Output	Alternating Current			
	Direct Current	Single-Phase	*Two-Phase 4-Wire	Three-Phase
	H.P. × 746	H.P. × 746	H.P. × 746	H.P. × 746
	E × EFF.	E × EFF. × P.F.	2 × E × EFF. × P.F.	1.73 × E × EFF. × P.F.
	KW × 1000	KW × 1000	KW × 1000	KW × 1000
	E	E × P.F.	2 × E × P.F.	1.73 × E × P.F.
		KVA × 1000	KVA × 1000	KVA × 1000
	I × E	E	2 × E	1.73 × E
		I × E × P.F.	I × E × P.F. × 2	I × E × P.F. × 1.73
	1000	1000	1000	1000
		I × E	I × E × 2	I × E × 1.73
		1000	1000	1000
	I × E × EFF.	I × E × EFF. × P.F.	I × E × 2 × EFF. × P.F.	I × E × 1.73 × EFF. × P.F.
	746	746	746	746
	I = Amperes		P.F. = Power Factor	
	E = Volts		KW = Kilowatts	
	EFF. = efficiency expressed as a decimal		KVA = Kilovolt-Amperes	
	H.P. = Horsepower			

*In two phase 3 wire circuits the current in the common conductor is 1.41 times that in either of the other two conductors.
Checked 1956

Clevis Mounting—Standard Rod



BORE	A	B	C	D	E	H	J	M	N	P	R	S	T	V		W	X
														Thread	Depth		
2	3 ³ / ₄	11 ⁷ / ₈	1 ³ / ₈	7 ₈	4	1 ¹ / ₄	7 ₈	1 ¹ / ₂	4 ³ / ₈	3	1	1	1 ⁵ / ₁₆	3 ⁴ -16	1 ³ / ₄	7 ₈	2 ⁹ / ₁₆
2 ¹ / ₂	4 ¹ / ₄	12 ³ / ₁₆	1 ¹ / ₂	1	4	1 ¹ / ₄	1	1 ¹ / ₂	4 ⁹ / ₁₆	3 ³ / ₈	1	1 ³ / ₈	1 ⁵ / ₁₆	1-14	2	1	2 ¹³ / ₁₆
3	4 ¹ / ₁₆	13 ³ / ₁₆	1 ³ / ₄	1 ¹ / ₄	4 ¹ / ₄	1 ³ / ₈	1 ¹ / ₄	3 ₄	4 ¹ / ₁₆	3 ³ / ₄	1 ³ / ₈	1 ³ / ₈	1 ¹ / ₈	1-14	2	1 ¹ / ₄	3 ¹ / ₃₂
3 ¹ / ₂	5 ³ / ₈	13 ⁵ / ₁₆	1 ³ / ₄	1 ¹ / ₂	4 ³ / ₄	1 ³ / ₈	1 ¹ / ₄	3 ₄	4 ¹ / ₁₆	4	1 ³ / ₈	1 ³ / ₈	1 ¹ / ₈	1-14	2	1 ¹ / ₄	3 ¹ / ₂
4	5 ³ / ₄	14 ³ / ₁₆	2	1 ³ / ₄	4 ³ / ₄	2	1 ¹ / ₂	3 ₄	4 ¹ / ₁₆	4 ¹ / ₄	1 ³ / ₄	1 ³ / ₄	1 ¹ / ₈	1 ¹ / ₄ -12	2	1 ¹ / ₂	3 ¹ / ₁₆
5	6 ⁷ / ₈	15 ⁹ / ₁₆	2 ¹ / ₄	2 ¹ / ₈	4 ³ / ₄	2 ⁷ / ₈	1 ³ / ₄	1	5 ³ / ₁₆	5 ¹ / ₈	2 ¹ / ₄	2	1 ³ / ₈	1 ¹ / ₂ -12	2	1 ³ / ₄	4 ¹ / ₄
6	8 ¹ / ₂	16 ⁵ / ₁₆	2 ¹ / ₂	2 ⁵ / ₈	5 ⁵ / ₈	2 ⁷ / ₈	2	1	5 ⁵ / ₈	5 ¹ / ₁₆	2 ¹ / ₄	2	1 ³ / ₈	1 ¹ / ₂ -12	2	2	5 ¹ / ₁₆
7	9 ⁷ / ₈	20	2 ³ / ₄	3 ¹ / ₄	6 ¹ / ₄	4	2 ¹ / ₂	1 ¹ / ₄	6 ³ / ₁₆	7 ¹ / ₁₆	2 ⁷ / ₈	2 ¹ / ₂	1 ³ / ₄	2-12	2 ¹ / ₂	2 ¹ / ₂	5 ³ / ₄
8	10 ⁷ / ₈	22 ⁹ / ₁₆	3	3 ³ / ₄	6 ³ / ₄	4	2 ¹ / ₂	1 ¹ / ₂	7 ¹ / ₁₆	8 ¹ / ₂	2 ⁷ / ₈	2 ¹ / ₂	2	2-12	2 ¹ / ₂	2 ¹ / ₂	6 ³ / ₈

Operating pressure up to 1500 lbs. p.s.i. Cylinder has male clevis tongue for extra strength. May be mounted vertically as well as horizontally. Should be ordered with rod head. When ordering cylinders always specify bore and stroke.

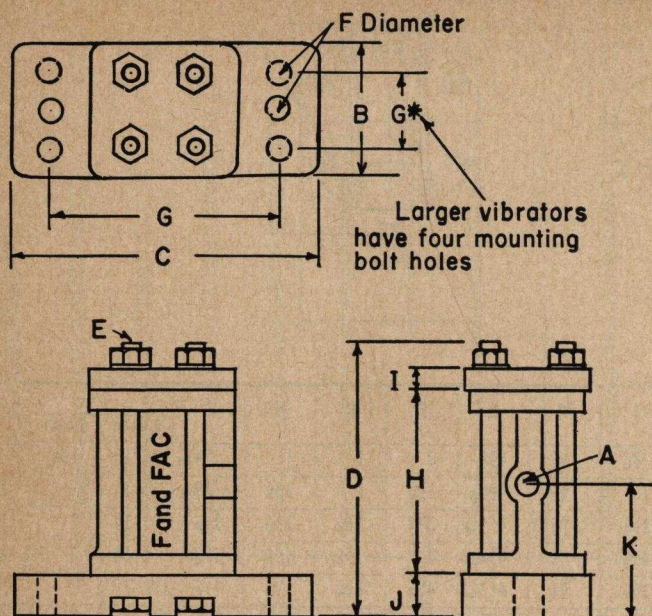
Courtesy, Logansport Machine Co., Inc., 1956

Fluid Displacement and Pressure Delivered by Standard Rod Hydraulic Cylinders

Size Diameter of Bore	Area of Bore	Cylinder Displacement for 1" of Piston Travel		APPROXIMATE POWER IN POUNDS PRESSURE					
				At 500 Lbs.		At 1000 Lbs.		At 1500 Lbs.	
		Push Cu. In.	Pull Cu. In.	Push Lbs.	Pull Lbs.	Push Lbs.	Pull Lbs.	Push Lbs.	Pull Lbs.
2	3.142	3.142	2.357	1571	1178	3142	2357	4713	3535
2 ¹ / ₂	4.909	4.909	3.424	2454	1712	4909	3424	7363	5136
3	7.069	7.069	5.584	3534	2792	7069	5584	10603	8376
3 ¹ / ₂	9.621	9.621	8.136	4810	4068	9621	8136	14431	12204
4	12.566	12.566	10.161	6283	5080	12566	10161	18849	15241
5	19.635	19.635	16.493	9817	8246	19635	16493	29452	24739
6	28.274	28.274	25.132	14137	12566	28274	25132	42411	37698
7	38.485	38.485	33.576	19242	16788	38485	33576	57727	50364
8	50.265	50.265	45.356	25132	22678	50265	45356	75397	68034

Courtesy, Logansport Machine Co., Inc., 1956

Pneumatic Vibrator Assembly Drawing



Piston Diameters of Vibrators (Heavy Duty)

	1"	1 1/4"	1 5/8"	2"	3"	3"	3"	4"	5"
A	1/4" NPT	1/4" NPT	1/4" NPT	1/4" NPT	3/8" NPT	1/2" NPT	3/4" NPT	3/4" NPT	3/4" NPT
B	2 1/2"	3"	4"	4"	6"	6"	7 1/2"	9"	9"
C	5"	6"	9"	9"	12"	12"	15"	16"	16"
D	4 5/8"	5 1/8"	8 5/8"	8 5/8"	9 1/2"	11 3/4"	15 1/4"	21 1/2"	21 1/2"
E	7/8" x	1 1/8" x	5/8" x	5/8" x	3/4" x	1" x	1 1/4" x	1 1/2" x	1 1/2" x
F	4 1/4"	5 1/4"	8"	8"	8 1/2"	10 1/2"	14 1/2"	20"	20"
G	3 1/2"	4 1/2"	7 1/2"	7 1/2"	9 1/2"	9 1/2"	12"	12"	12"
H	2.780"	3.600"	5 1/8"	5.562"	5 7/8"	7 7/8"	10 3/8"	15"	15"
I	1 1/4"	1 1/2"	5/8"	5/8"	1"	1"	1 1/4"	1 1/2"	1 1/2"
J	3/4"	1"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	2"	2 1/4"	2 1/4"
K	2 3/4"	2 1/2"	4 3/4"	4 3/4"	4 7/8"	5 1/8"	7 3/8"	9 3/4"	9 3/4"

Courtesy, The Cleveland Vibrator Co., 1956

How to Figure Motor Size

To determine the size of electric motor needed for a given job, the formula may be used:

$$\frac{\text{HP Output Req'd.}}{\text{ME} \times \text{PF} \times \text{LE}} = \text{size of motor needed}$$

Where:

HP Output Req'd. is the power required to move the loaded machine.

ME is the motor efficiency.

PF equals power factor.

LE is line efficiency, or voltage output divided by voltage input.

For example: An electric motor is required to operate a shale planer which when under load puts a demand of 50 horsepower on the power source. Power at the plant's connection to a nearby public power line is 440 volts, but due to the resistance of the No. 2 wire used to span the 2,000 ft. distance to the shale planer, the power at the motor is only 410 volts. With a motor of 85 percent efficiency, in a plant where the power factor is 85 percent, the formula becomes:

$$\frac{50}{.85 \times .85 \times \frac{410}{440}} = \text{size of motor needed}$$

$$\frac{50}{.723 \times .93} = \text{size of motor needed}$$

$$\frac{50}{.67} = 74.6 \text{ or a 75 HP motor is needed}$$

Checked 1956

Breakdown Torques, Single-Phase, Integral H.P. Induction Motors

3600 RPM Sync.	Breakdown Torque (lb-ft)			HP
	1800 RPM Sync.	1200 RPM Sync.		
....	....	5.16- 6.9		3/4
....	5.16- 6.8	6.9 - 9.2		1
3.6- 4.6	6.8 -10.1	9.2 -13.8		1 1/2
4.6- 6.0	10.1 -13.0	13.8 -18.0		2
6.0- 8.6	13.0 -19.0	18.0 -25.8		3
8.6-13.5	19.0 -30.0	25.8 -40.5		5
13.5-20.0	30.0 -45.0	40.5 -60.0		7 1/2
20.0-27.0	45.0 -60.0	....		10

Courtesy, General Electric Co., 1953

Bin Size and Vibrator Requirements

Maximum Hopper Capacity	Normal Thickness Hopper Metal	Cleveland Metallic Impact Size	Cleveland Air-Cushioned Size	Cleveland Electric Size
7 cu. ft.	1/16 ga.	3/8" SA	1" AC	MC-1.5
15 cu. ft.	1/16 ga.	1" F	1 1/4" FAC	MC-3
20 cu. ft.	1/8 ga.	1 1/4" F	1 5/8" FAC	MC-3
35 cu. ft.	1/8 ga.	1 5/8" F	2" FAC	RC-10 with 1/2
50 cu. ft.	3/16 ga.	2" F	3" FAC	eccentrics
15 ton	5/16 ga.	3" F	3" LSFAC	RC-10
35 ton	3/8 ga.	3" LSF	3" LSFAC	RC-30
50 ton	3/8 ga.	4" LSF		RC-50
70 ton	1/2 ga.	5" LSF		

Recommendation Sheet for installation of Cleveland Vibrators on hoppers and bins of average construction containing average granular materials. Rigidity of construction, high moisture content, unusual flow characteristics, etc., will alter these recommendations.

Courtesy Cleveland Vibrator Co., 1956

Locked-rotor Torque of Normal-starting-torque Squirrel cage Motors—NEMA Design A or B

Hp 60-cycle 3- and 2- phase Single-speed Motors Continuous- rated	Locked-rotor Torque Expressed in Per Cent of Full-load Torque			
	3600 Rpm	1800 Rpm	1200 Rpm	900 Rpm
1	175	275	175	150
1 1/2	175	265	175	150
2	175	250	175	150
3	175	250	175	150
5	150	185	160	130
7 1/2	150	175	150	125
10	150	175	150	125
15	150	165	140	125
20	150	150	135	125
25	150	150	135	125
30	150	150	135	125
40	135	150	135	125
50	125	150	135	125
60	125	150	135	125
75	110	150	135	125
100	110	125	125	125

Courtesy, General Electric Co., 1953

Machinery and Equipment

19

Capacities, Horsepower and Speeds of Screw Conveyors

Ground Clay at 90 lbs. per Cubic Foot. The Capacities Will Be Smaller if the Clay or Shale Has Lumps in it.

Dia. of Conv. Ins.	Speed R.P.M.	Tons per Hour	Mate- rial Flow F.P.M.	Horsepower for Foot Length									
				20	30	40	50	75	100	125	150	175	200
6	95	5.64	47	.28	.42	.56	.70	1.05	1.40	1.75	2.10	2.45	2.8
9	75	19.75	57	.99	1.49	1.98	2.48	3.71	4.95	6.19	7.43	8.66	9.9
12	70	40.42	70	2.05	3.08	4.10	5.13	7.69	10.25	12.81	15.38	17.94	20.5
14	65	63.92	74	3.20	4.80	6.40	8.00	12.00	16.00	20.00	24.00	28.00	32.0
16	60	90.24	80	4.50	6.75	9.00	11.25	16.88	22.50	28.13	33.75	39.38	45.0
18	55	117.58	83	5.87	8.81	11.74	14.68	22.01	29.35	36.69	44.03	51.36	58.7
20	50	148.46	84	7.47	11.21	14.94	18.68	28.01	37.35	46.69	56.03	65.36	74.7
22	45	179.54	83	8.98	13.47	17.96	22.45	33.68	44.90	56.13	67.35	78.58	89.8

Coal (Screenings or Small Sized Coal) with No Lumps Larger Than 1 Inch

Dia. of Conv. Ins.	Speed R.P.M.	Tons per Hour	Mate- rial Flow F.P.M.	Horsepower for Foot Length									
				20	30	40	50	75	100	125	150	175	200
9	85	15	64	.75	1.13	1.5	1.88	2.81	3.75	4.69	5.63	6.50	7.5
12	75	30	75	1.50	2.25	3.0	3.75	5.63	7.50	9.38	11.25	13.13	15.0
14	70	40	82	2.00	3.00	4.0	5.00	7.50	10.00	12.50	15.00	17.50	20.0
16	65	60	87	3.00	4.05	6.0	7.50	11.25	15.00	18.75	22.50	26.25	30.0
18	60	80	90	4.00	6.00	8.0	10.00	15.00	20.00	25.00	30.00	35.00	40.0
20	55	100	92	5.00	7.50	10.0	12.50	18.75	25.00	31.25	37.50	43.75	50.0
22	50	125	92	6.25	9.38	12.5	15.63	23.44	31.25	39.06	46.88	54.69	62.5

Checked by Link-Belt Co., 1952

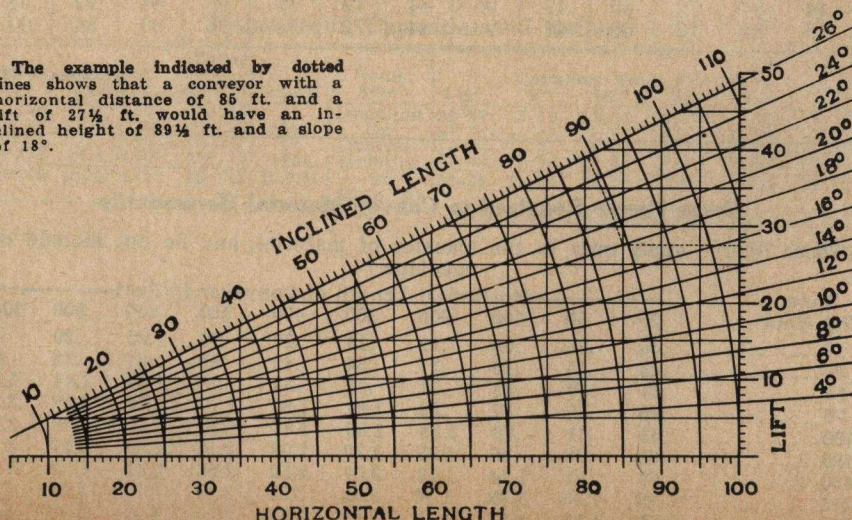
Standard Sizes and Dimensions of Drum Hoist

Total Rope Pull (lbs.)	Dia. of Drum (in.)	Rope Vel. 400 Ft. P.M.		Std. Size of Driving Pulley (in.)	Size of Rope (in.)	Length of Drum (in.)	Winding Capacity of Drum (ft.)
		R.P.M.	Max. H.P.				
2250	24	288	27	32x 8½	¾	24 30 36	240 300 360
2300	20	285	28	32x 8½	¾	30 37 44	250 310 370
2770	36	285	33	36x12½	¾	36 42 48	450 530 610
3320	30	340	40	36x12½	¾	36	380
3340	27	340	41	36x12½	¾	51	470
4160	24	424	50	36x12½	7/8	36	260

Checked 1956

Chart for Finding Inclined Length and Degree of Slope for Inclined Belt Conveyors

The example indicated by dotted lines shows that a conveyor with a horizontal distance of 85 ft. and a lift of 27½ ft. would have an inclined height of 89½ ft. and a slope of 18°.



Checked by Robins Conveyor Div., Hewitt-Robins Inc.

Commercial Wire Cloth Table

Plain Mesh	Diameter	Holes	Open Area
80	.0055"	.0070"	31.4%
90	.0050"	.0061"	30.1%
100	.0045"	.0055"	30.3%
110	.0040"	.0051"	31.4%
120	.0037"	.0046"	30.7%
130	.0034"	.0043"	31.1%
140	.0029"	.0042"	34.9%
150	.0026"	.0041"	37.4%
160	.0025"	.0038"	36.4%
170	.0024"	.0035"	35.1%
180	.0023"	.0033"	34.7%
190	.0022"	.0031"	34.2%
200	.0021"	.0029"	33.6%
220	.0017"	.0028"	33.7%
240	.0016"	.0026"	33.3%
250	.0016"	.0024"	36.0%
Twilled Meshes			
110	.0045"	.0046"	25.6%
120	.0040"	.0043"	26.8%
130	.0038"	.0039"	25.6%
140	.0033"	.0038"	28.6%
150	.0030"	.0037"	30.4%
160	.0028"	.0035"	30.8%
170	.0026"	.0033"	31.2%
180	.0025"	.0031"	30.6%
190	.0024"	.0029"	29.9%
200	.0023"	.0027"	29.1%
220	.0019"	.0026"	33.3%
230	.0018"	.0025"	34.3%
240	.0017"	.0025"	35.5%
250	.0016"	.0024"	36.0%
260	.0016"	.0022"	33.6%
270	.0016"	.0021"	32.2%
280	.0016"	.0021"	30.8%
300	.0015"	.0018"	29.7%
325	.0014"	.0017"	30.0%
400	.0010"	.0015"	36.0%

Checked by Cambridge Wire Club Co., 1953

Contents of Cylindrical Tanks Placed Vertically

Tank Diam. (In.)	Gal. Per Ft. Depth
12	5.88
18	13.219
24	28.50
30	36.72
36	52.90
42	71.97
48	94.00
54	113.97
60	146.88
66	177.72
72	211.50
78	248.23
84	287.88
90	330.48
96	376.01
102	424.48
108	475.89
114	530.24
120	587.52

Checked 1956

Maximum Feed Size of Roll Crushers

Dia. of Rolls	Size of Pieces
9"	.36"
12"	.48"
18"	.72"
24"	.96"
26"	1.04"
30"	1.20"
36"	1.44"
40"	1.60"
42"	1.68"
48"	1.92"
54"	2.16"
72"	2.88"

Plus the spread of the Rolls equals maximum size of pieces which Rolls will take.

To the above maximum size of feed should be added the opening between rolls faces, for instance—the maximum size piece which should be fed to rolls 30 inches diameter set ¾ inch apart would be 1.45 inches.

Checked by Allis-Chalmers Mfg. Co., 1952

Wire Rope Clips Required to Obtain 80% Rope Strength

Diameter of Rope	Number of Clips	Space in Inches Between Clips
3/4 and smaller	3	3 3/4
3/4	4	4 1/2
7/8	4	5 1/4
1	4	6
1 1/8	4	7
1 1/4	5	8
1 3/8	6	9
1 1/2	6	10
1 5/8	6	10
1 3/4	6	11
1 7/8	7	12
2	7	12

Checked 1952 by A. Leschen & Sons Rope Co.

Recommended Maximum Sizes of Pieces to Be Handled on the Different Widths of Belts

12 inch belt—	2 inch pieces
18 inch belt—	4 inch pieces
24 inch belt—	8 inch pieces
30 inch belt—	14 inch pieces
36 inch belt—	18 inch pieces
48 inch belt—	24 inch pieces

Checked by Stephens-Adamson Mfg. Co., 1952

Recommended Bucket Speeds and Head Wheel Diameters

Averages for good centrifugal discharge and good bucket pick-up

Head Whl. Dia., In.	Spaced Buckets RPM	Head Whl. Dia., In.	Spaced Buckets RPM
15	50.2	197	42
18	46.3	218	48
20	42.8	225	54
24	41.4	260	60
26	40.0	272	66
30	38.2	300	72
36	34.3	323	

Courtesy, Stephen-Adamson Mfg. Co., 1952

Disc Feeder Settings*

Typical Disc Feeder Settings For Securing Constant Proportioning. These were used as an instruction sheet for pug mill operator.

	50 Coarse	50 Fine			
Coarse	6	5 1/2	5	4 1/2	3 3/4
Fine	9	8 3/4	8	7	6

	50 Intermediate	50 Fine			
Interme-	6 1/2	6	5 1/2	5	4 1/2
diate	8 1/2	7 1/2	6 1/2	6	5 1/2
Fine	8 1/2	7 1/2	6 1/2	6	5 1/2

	Special Mix				
Coarse	2 1/2	2	1 1/2	1 1/4	
Interme-	2	2	1 1/2	1 1/4	
diate	2	2	1 1/2	1 1/4	
Fine	8	7	6	4 1/2	

*Characteristics of clay will alter settings

Checked 1956

Maximum Safe Inclinations for Troughed Belt Conveyors

Material	Slope (Degrees)
Clay, fine dry	20
Clay, wet damp	20-22
Coal, mine run	18
Coal, sized	+4"—15°
Coal, sized	+4"—16°
Coke, oven run	18
Glass batch	20
Sand, dry	15
Sand, damp	20
Stone, crushed	fine—20°
Stone, crushed	+4"—16°
Stone, crushed	+4"—15°

Checked 1956

Induction and Dielectric Heating Data—Physical Constants of Metals (20° C Unless Otherwise Specified)

Material	Resistivity Microhms/CC	Temp. Coefficient of Resistance	Specific Gravity	Specific Heat	Coeff. Thermal Cond.
Aluminum	2.688	.00403	2.70	.214	.5
Barium	9.8	.0033	3.78	.068	
Beryllium	10.1			.397	
Brass	8	.002	8.6	.392	.204
Bronze	17.8	.0005	8.8	.086	
Carbon	3500 at 0°	.0009	3.52	.165	
Calcium	4.59	.00364 (0-600)	1.54	.157	
Chromium	2.6 at 0°		6.92	.11	
Cobalt	9.7	.00658 (0-100)	8.71	.10	
Copper	1.724	.00393	8.89	.0921	.918
Gold	2.44	.0034	19.3	.0312	.7
Graphite	800 at 0		2.25	.17	
Iron	9.8	.0065 (0-100)	7.8	.107	.161
Iron Cast	79-104		7.03	.118	
Lead	22.0	.0039	11.4	.0306	.083
Magnesium	4.46	.004	1.74	.246	.376
Manganese	5		7.42	.121	
Mercury	95.8	.00089	13.59	.033	.015
Molybdenum	5.08 at 0	.0047 (0-100)	9.0	.065	.346
Monel Metal	42	.002	8.9	.062	.062
Nickel	7.8	.00537 (20-100)	8.9	.105	.142
Platinum	9.83 at 0	.003	21.4	.0324	.166
Potassium	6.1 at 0	.0055 at 0	.851	.19	
Silver	1.629 at 18	.0038	10.5	.056	1.0
Sodium	4.3 at 0	.0054	.951	.295	
Steel (Soft)	11.8	.004	7.7	.118	.115
Steel (Hard)	45.6	.0016	7.7	.118	.115
Steel (Nickel)	30-85	.0007	7.7	.118	.115
Tantalum	15.5	.0031	16.6	.036	.130
Thallium	17.6 at 0	.0040 at 0	11.86	.038	
Thorium	18	.0021 (20-1800)	11.5	.027	
Tin	11.5	.0042	7.3	.054	.155
Tungsten	5.5	.0047 (0-100)	19	.034	.476
Zinc	5.75 at 0	.0037	7.1	.093	.265

Checked by Industrial Electronics & X-Ray Div., Westinghouse Electric Corp., 1952

Normal Pulley Diameters for Belt Conveyors

No. of Plies	28 Oz.				32 Oz.				36 and 42 Oz.			
	Tan-dem Drive	Head and Trip-per	Tail Take-up	Low Tension Snub	Tan-dem Drive	Head and Trip-per	Tail Take-up	Low Tension Snub	Tan-dem Drive	Head and Trip-per	Tail Take-up	Low Tension Snub
3	18	15	12	10	24	18	15	12				
4	24	20	18	12	30	24	20	15				
5	30	24	20	15	36	30	24	18	42	36	30	24
6	36	30	24	18	42	36	30	24	48	42	36	24
7	42	36	30	24	48	42	36	24	54	48	36	30
8	48	42	30	24	54	48	36	30	60	54	42	36
9	54	48	36	30	60	54	42	36	72	60	48	36
10	60	48	42	30	72	60	48	36	72	60	54	42
11	60	54	48	36	72	60	48	42	84	72	60	48
12	72	60	48	36	84	72	54	42	84	72	60	48
13	72	60	54	42	84	72	60	48	96	84	72	54
14	84	72	60	42	96	84	72	48	96	84	72	54
15	84	72	60	48	96	84	72	54	96	96	84	60

Checked 1956

Horse Power Required to Convey Material Horizontally

(These figures apply only to the transfer of material, and do not include the machine.)

Tons Per Hour	Horizontal Length of Conveyor in Feet									
	25	50	100	200	300	400	500	600	800	1000
10	.05	.06	.08	.11	.14	.17	.20	.23	.29	.35
25	.13	.15	.19	.27	.34	.42	.49	.57	.72	.87
50	.27	.30	.38	.53	.68	.83	.98	1.14	1.44	1.74
75	.40	.45	.57	.80	1.01	1.25	1.47	1.70	2.16	2.61
100	.53	.61	.76	1.06	1.36	1.67	1.97	2.27	2.88	3.48
125	.66	.76	.95	1.33	1.70	2.08	2.46	2.84	3.60	4.35
150	.79	.91	1.14	1.59	2.04	2.50	2.95	3.41	4.32	5.22
175	.93	1.06	1.33	1.86	2.39	2.92	3.45	3.98	5.04	6.10
200	1.06	1.21	1.52	2.12	2.72	3.33	3.94	4.55	5.76	6.96

Checked 1956

Contents of Horizontal Cylindrical Tanks When Filled to Various Depths

Tanks with Flat Ends—Contents in U. S. Gallons per 1 Foot of Length

Diam. of Tank, In.	Full Tank	Depth of liquid in inches — h.																	
		3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
12	5.88	1.15	2.94																
18	13.22	1.45	3.86	6.61															
24	23.50	1.70	4.60	8.05	11.75														
30	36.72	1.91	5.23	9.27	13.72	18.36													
36	52.88	2.12	5.79	10.34	15.43	20.85	26.44												
42	71.97	2.28	6.31	11.31	16.97	23.07	29.47	35.99											
48	94.01	2.45	6.78	12.00	18.38	25.10	32.20	39.54	47.00										
54	118.98	2.60	7.22	13.04	19.68	26.97	34.72	42.80	51.08	59.49									
60	146.89	2.75	7.64	13.82	20.91	28.72	37.06	45.82	54.87	64.11	73.44								
66	177.73	2.89	8.04	14.56	22.07	30.37	39.28	48.65	58.39	68.41	78.59	88.86							
72	211.52	3.02	8.42	15.26	23.17	31.92	41.36	51.32	61.71	72.45	83.41	94.54	105.76						
78	248.24	3.15	8.78	15.94	24.21	33.41	43.34	53.86	64.87	76.27	87.97	99.90	111.97	124.13					
84	287.90	3.26	9.12	16.57	25.24	34.85	45.24	56.29	67.87	79.91	92.30	104.98	117.85	130.87	143.95				
90	330.49	3.43	9.46	17.20	26.20	36.21	47.05	58.61	70.75	83.39	96.43	109.81	123.45	137.28	151.23	165.25			
96	376.02	3.50	9.79	17.80	27.13	37.52	48.81	60.84	73.52	86.73	100.39	114.44	128.79	143.40	158.17	173.06	188.01		
102	424.50	3.61	10.10	18.37	28.01	39.00	50.49	62.99	76.18	89.94	104.20	118.89	133.92	149.25	164.81	180.53	196.37	212.25	
108	476.10	3.71	10.39	18.94	28.90	40.03	52.14	65.09	78.74	93.04	107.87	123.17	138.87	154.89	171.19	187.71	204.37	221.14	238.05
114	530.25	3.78	10.74	19.49	29.75	41.22	53.73	67.10	81.24	96.05	111.43	127.31	143.63	160.33	177.33	194.60	212.05	229.65	247.37
120	587.54	3.91	10.98	20.02	30.57	42.39	55.26	69.06	83.65	98.95	114.87	131.32	148.25	165.58	183.27	201.24	219.46	237.87	256.43

To ascertain contents of tank, multiply number of gallons from above table by length of tank in feet.
To ascertain contents of tank over one-half full, measure height of empty portion of tank. In the above table, find the quantity corresponding to this height and subtract this quantity from the contents of a full tank. Multiply this by the length of the tank.

Checked 1956

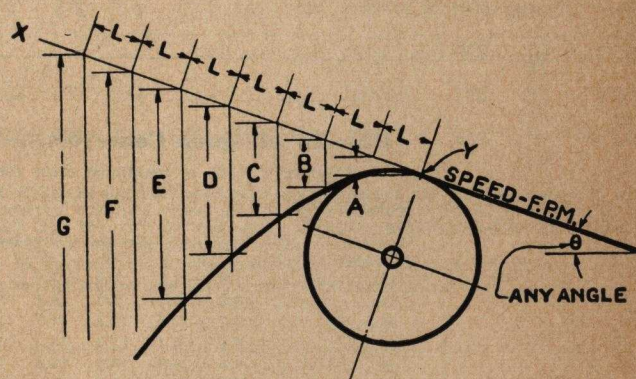
How to Determine Discharge Curve of a Belt Conveyor

Material as it is discharged from a belt, would continue to travel in the direction and at the speed of the belt except as it is acted upon by two forces, i.e., the force of gravity and the resistance of the air, the latter of which being small is omitted from the following calculations.

In the handling of any materials except those which are very light and easily deflected by the resistance of the air or materials which tend to stick to the belt, the discharge from the belt may be determined as follows: In a drawing, to any convenient scale, indicate the discharge pulley and the angle of the belt to the horizontal as shown in the sketch upon this page and continue the direction of the belt in the line "XY." On this line from "Y" lay out the equal dimensions L.L.L., etc., where L in inches equals speed of belt in feet per minute, divided by 100. At the end of the various spaces L.L. drop down vertically the dimensions A. B. C. D., etc., in inches, taken from the table below.

Then to find the trajectory or path of the material as it leaves the belt,

The accompanying diagram shows a method for plotting the true discharge curve of a belt conveyor. Complete instructions for plotting this curve will be found on this page. It is often desirable to know the exact discharge curve, especially in slow speed conveyors, to aid in placing the discharge chute in the correct position.



Discharge Curve of Material from Belt

draw a continuous curve from the point Y thru the bottom of the successive dimensions A. B. C. D., etc.

At the maximum speed of belts, there is seldom an occasion to obtain the true path of the delivery of material. However, for slow speeds it is often necessary to find the highest point in the face of the pulley at which a discharge chute may be placed

where breakage is a consideration.

A	Decimal	Fraction Inches	I	Decimal	Fraction Inches
B	.43	1/2	J	39.07	39 1/2
C	1.93	1 1/2	K	48.24	48 1/4
D	4.34	4 1/4	L	58.37	58 3/8
E	7.72	7 3/4	M	69.47	69 1/2
F	12.06	12 1/8	N	81.53	81 1/2
G	17.37	17 1/4	O	94.55	94 1/2
H	23.64	23 3/4		108.54	108 1/2
	30.87	30 3/4			

Checked 1956

Hammermill Capacities and Ratings

Mill Size	Hopper Opening	Horse Power (Motor)	Speed	Feed Size	Capacity Tons Per Hour					
					1 1/2"	1"	3/4"	1/2"	1/4"	1/8"
30x16	17 1/2"x20"	30-40	1000 To 1200 R.P.M.	Depends On Characteristics of Material	20-22	15-18	12-14	10-12	5-10	4-6
30x22	23"x20"	40-50			27-30	20-23	15-18	13-15	10-14	6-10
30x28	28 1/2"x20"	50-75			35-40	25-28	20-23	18-20	15-19	12-15
30x40	39 1/4"x20"	75-125			50-55	35-40	30-33	25-30	22-28	18-22

Submitted 1952 by American Pulverizer Co.

Checked 1956

Operating Data for Air Separators

Diam. Feet	Approx. Capacity Tons per Hr.	Approx. Horse-power	Pulley Speed R.P.M.
3'	1/4 to 1	3 to 5	900 to 1200
6'	1 to 3	7 1/2 to 10	550 to 650
8'	3 to 8	15 to 20	550 to 650
10'	5 to 15	20 to 30	550 to 600
12'	8 to 23	30 to 40	600 to 650
14'	10 to 30	40 to 60	590
16'	13 to 38	75 to 100	590

Checked 1956

Capacities in Cubic Yards per Hour of Cableways on Average Hauls of Various Lengths of Span when Using Different Sizes of Buckets

Size of Bucket	300-ft. Span 200-ft. Average Haul	400-ft. Span 250-ft. Average Haul	500-ft. Span 300-ft. Average Haul	600-ft. Span 350-ft. Average Haul	700-ft. Span 400-ft. Average Haul	800-ft. Span 450-ft. Average Haul	900-ft. Span 500-ft. Average Haul
1/3 cu. yd.....	12-17	12-17	12-16	.....	.....	.....	.....
1/2 cu. yd.....	19-26	19-26	18-24	.....	.....	.....	.....
3/4 cu. yd.....	30-40	30-40	27-36	25-33	.....	.....	.....
1 cu. yd.....	38-52	38-52	36-48	33-44	30-40	.....	.....
1 1/2 cu. yd.....	58-78	58-78	54-72	50-66	45-60	41-54	39-52
2 cu. yd.....	78-104	78-104	72-96	66-88	60-80	54-72	52-70
2 1/2 cu. yd.....	97-130	97-130	90-120	83-110	75-100	68-90	65-87
3 cu. yd.....	114-156	114-156	108-144	99-132	90-120	81-108	78-105
3 1/2 cu. yd.....	133-182	133-182	125-168	115-154	105-140	95-126	91-122

Note.—The maximum capacities in the above table represent what each size of cableway can produce in handling ordinary sand and gravel and assume use of a hoist that will operate the bucket at a speed of 200 ft. per minute when digging, 600 ft. per minute when being hauled in, and 1,200 ft. per minute when returning to the point of excavation. If the material is unusually difficult to dig; or the work calls for too much shifting of the line of operation, or the operator is not efficient, the output may be decreased to the extent represented by the minimum capacities given above.

Checked 1956

Table of Rails

Pounds per yard	Gross Tons per Mile of Track	Feet of Single Track per Gross Ton
8	12.57	120
10	15.71	336
12	18.86	280
14	22.00	240
16	25.14	210
20	31.43	168
25	39.29	134.4
30	47.14	112
35	55.00	96
40	62.86	84
45	70.71	74.67
50	78.57	67.20
52	81.71	64.61
55	86.43	61.08
56	88.00	60
60	94.29	56

Checked 1956

Selecting Electric Vibrators

The figures in the table give approximate recommendations as to the proper weight of vibrators to use on bins or hoppers of various capacities.

Capacity of Hopper (Lbs.)	Thickness of Metal (Inches)	Weight of Vibrator (Lbs.)
200	1/16	9
400	1/8	13
800	3/16	22
1,500	1/4	40
12,000	...	98

Checked 1956

Capacity of Apron Conveyors in Tons Per Hour at 10 Ft. Per Minute

(Loading to 75% of maximum cross section; material weighing 50 lbs. per cu. ft.)

Actual Width of Carrying Surface (Inches)	Average Depth of Material (Inches)											
	2	3	4	5	6	7	8	10	12	14	16	18
18.....	2.8	4.2	5.6	7.0	8.4	9.8	11.3	14.1	16.9	.....	.....	.....
24.....	3.8	5.6	7.5	9.4	11.3	13.1	15.0	18.8	22.5	26.3	30.0	33.8
30.....	4.7	7.0	9.4	11.7	14.1	16.4	18.8	23.4	28.1	32.8	37.5	42.2
36.....	5.6	8.4	11.3	14.1	16.9	19.7	22.5	28.1	33.8	39.4	45.0	50.6
42.....	6.6	9.8	13.1	16.4	19.7	23.0	26.2	32.8	39.4	45.9	52.5	59.1
48.....	7.5	11.3	15.0	18.8	22.5	26.3	30.0	37.5	45.0	52.5	60.0	67.5
54.....	8.4	12.7	16.9	21.1	25.3	29.5	33.8	42.2	50.6	59.1	67.5	75.9
60.....	9.4	14.1	18.8	23.4	28.1	32.8	37.5	46.9	56.3	65.6	75.0	84.4

Checked 1956

Capacities in Tons Per Hour for Belt Conveyors

Weight per Cu. Ft.												Cross Sec- tion of Load Square Feet	Cu. Ft. per Hr. at 100 F.P.M.	Cu. Yds. per Hr. at 100 F.P.M.	
Width of Belt	Ma- terial	Capacity in Tons per Hour													
		Belt Speed—F.P.M.													
		100	150	200	250	300	350	400	450	500	550	600			
14"	50	16	24	32	41	49									
	75	24	37	49	61	73	...	...	...	...	...	...	...	...	...
	100	32	49	65	81	97	...	...	...	...	...	...	108	648	24
	125	40	61	81	102	122	...	...	...	...	...	...	...	...	...
16"	50	21	32	42	53	63	...	...	...	...	...	...			
	75	31	47	63	79	94	...	...	...	...	...	...			
	100	42	63	84	105	126	...	...	...	...	...	...	140	840	31
	125	52	79	105	131	157	...	...	...	...	...	...	...	...	...
18"	50	27	41	54	68	81	95	108	...	...	...	...			
	75	40	61	81	101	121	142	162	...	...	...	...			
	100	54	81	108	135	162	189	216	...	...	...	...	180	1080	40
	125	67	101	135	169	202	236	270	...	...	...	...	...	...	...
20"	50	34	51	67	84	101	118	135	...	...	...	...			
	75	51	76	101	127	152	177	202	...	...	...	...			
	100	67	101	135	169	202	236	270	...	...	...	...	225	1350	50
	125	84	127	169	211	253	295	337	...	...	...	...	...	...	...
24"	50	50	75	100	125	150	175	200	225	250	...	...			
	75	75	112	150	187	225	262	300	337	375	...	...			
	100	100	150	200	250	300	350	400	450	500	...	...	333	2000	74
	125	125	187	250	312	375	437	500	562	625	...	...	...	...	...
30"	50	81	121	162	202	243	284	324	364	405	...	...			
	75	121	182	243	304	365	425	486	546	608	...	...			
	100	162	243	324	405	486	567	648	729	810	...	...	540	3240	120
	125	202	304	405	506	608	708	810	911	1013	...	...	...	...	...
36"	50	117	177	235	293	352	413	470	528	587	646	705	...	...	...
	75	176	264	352	440	529	616	705	792	881	968	1057	...	...	...
	100	235	351	470	586	705	822	940	1055	1175	1292	1410	783	4700	174
	125	294	441	587	735	881	1029	1175	1313	1469	1616	1762	...	...	...

*Based on 60% Cross-Sectional Load.

Checked 1956

Operating Data for Single Roll Crushers

Size of Crusher		Normal Speed		Max. Size of Feed Inches	Capacity Tons per Hour For Various Size Products					Horse Power at Listed Capacity For Various Size Products				
Roll Dia.	Roll Width	Roll R.P.M.	Drive Shaft R.P.M.		1 1/4"	1 1/2"	2"	3"	4"	1 1/4"	1 1/2"	2"	3"	4"
18"	18"	75	300	10	30	40	55	60	65	11	13	15	12	10
18"	24"	75	300	10	40	55	75	80	85	14	18	20	16	13
24"	24"	60	240	16	65	90	100	125	140	23	29	27	25	20
24"	30"	60	240	16	85	120	130	160	180	30	38	34	32	25
30"	30"	50	200	22	130	170	200	250	270	46	53	53	49	38
30"	36"	50	200	22	160	210	240	300	330	56	66	64	59	46
36"	36"	40	160	24	270	350	420	500	570	95	110	111	100	80
36"	48"	40	160	24	370	470	570	670	770	130	148	151	132	110

Checked 1956

Gyratory Crusher Operating Data

Non-Choking Concaves

Size of Crusher in Inches	Two re- ceiving Openings Each in Inches*	Approximate Capacity per Hour in Tons of 2,000 Pounds—														Driving Size in Inches	Pulley Maxi- mum R.P.M.	H.P. Re- quired	Weight of Crusher in Pounds	
		Size of Discharge Opening Open Side in Inches*																		
		½	⅝	¾	⅞	1	1⅛	1¼	1½	1⅝	2	2¼	2½	3	3½					4
6	6x40	24	27	40	44	49	54	60	69	.....	.....	.....	.....	.....	.....	.....	28x12½	650	50 75	33,500
10	10x52	....	....	....	....	....	100	106	118	132	182	198	214	....	....	....	32x19	575	100 150	67,000
18	18x68	....	....	....	....	....	....	....	....	310	345	380	455	545	640	735	38x25	460	150 200	187,000

*Capacities are based on crushers fitted with non-choking concaves and while the crusher receiving openings are of the widths listed, the width at which crushing starts is less when the crushers are set at the smaller discharge openings. Thus the effective width for the 6" crusher with discharge openings below 1/4 inch is approximately 4 inches. The effective width for the 10" crusher with discharge openings below 1 1/4 inches is approximately 6 1/4 inches. The effective width for the 18" crusher is 18 inches for all the settings listed.

The power required will vary according to the character of material to be crushed, the crusher setting and the capacity required.

The capacity is based on crushing rock which will feed into the crusher readily and weighs 100 lbs. per cubic foot crushed.

Checked 1956

Factors in the Grinding of Refractory Materials in Conical Ball or Pebble Mills

Size of Mill	Feldspar		Silica sand		Enamel frit		Grog		Ganister Rock (pan tailings)		Zircon Sand		Corundum		Chrome Clinker		Ilmenite	
	8' x 60"	2"	8' x 48"	20 mesh	4 1/2' x 16"	1/2"	5' x 22"	1 1/2"	8' x 22"	1/2"	8' x 36"	40 mesh	8' x 48"	14 mesh	6' x 48"	1/2"	8' x 72"	40 mesh
Feed Size	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Size of Product	99% thru 200 mesh	.....	98% thru 325 mesh	.....	97% thru 100 mesh	.....	95% thru 10 mesh	.....	90% thru 65 mesh	.....	99% thru 400 mesh	.....	99% thru 325 mesh	.....	55% thru 200 mesh	.....	97% thru 200 mesh	.....
Capacity, tons/hr.	1.75	.....	1.25	.....	0.225	.....	5	.....	5	.....	0.6	.....	0.3	.....	1.75	.....	6.1	.....
Power for Mill, h.p.	68	.....	58	.....	8.5	.....	28	.....	125	.....	50	.....	55	.....	65	.....	270	.....
Power for Auxiliaries, h.p.	21	.....	20	.....	.....	.....	3	.....	25	.....	7.5	.....	7.5	.....	17	.....	50	.....
Pebble or Ball Load, lbs.	10,000	.....	12,000	.....	2,000	.....	2,800	.....	25,000	.....	8,500	.....	9,500	.....	10,000	.....	39,000	.....
Speed of Mill, r.p.m.	22	.....	18	.....	30	.....	30	.....	23	.....	20.5	.....	22	.....	25.6	.....	20	.....
Moisture, %	1	.....	1	.....	0	.....	1	.....	1	.....	1	.....	Bone dry	.....	2	.....	Bone dry and hot	.....
Type of Classifier	Hardinge	.....	Air	.....	Trommel screen on mill	.....	Closed circuit with screen	.....	Open circuit	.....	Hardinge	.....	Hardinge	.....	Hardinge	.....	Hardinge	.....
Grinding media	Flint pebbles	.....	Flint pebbles	.....	Flint pebbles	.....	Steel	.....	Steel	.....	Flint pebbles	.....	Flint pebbles	.....	Steel	.....	Steel	.....
Lining Type	Flint blocks	.....	Flint blocks	.....	Flint blocks	.....	Steel	.....	Steel	.....	Flint blocks	.....	Flint blocks	.....	Steel	.....	Steel	.....

Checked 1956

Centrifugal Pump Data (DC and 60-Cycle AC*)

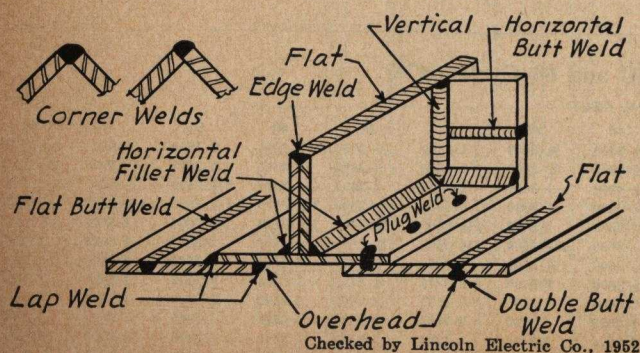
TOTAL HEAD IN FEET														
G.p.m.	10	15	20	25	30	35	40	45	50	55	60	65	70	75
10....Hp.-R.p.m.	¼-1800	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	1-3600	1-3600	1-3600	1-3600	1-3600	1½-3600
20....Hp.-R.p.m.	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	1-3600	1-3600	1-3600	1-3600	1-3600	1½-3600
30....Hp.-R.p.m.	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	1-3600	1-3600	1-3600	1-3600	1½-3600	1½-3600	1½-3600
40....Hp.-R.p.m.	¼-1800	¼-3600	¼-3600	¼-3600	¼-3600	¼-3600	1-3600	1-3600	1-3600	1½-3600	1½-3600	1½-3600	1½-3600	1½-3600
50....Hp.-R.p.m.	½-1800	½-1800	½-3600	¾-3600	¾-3600	1-3600	1-3600	1-3600	1½-3600	1½-3600	1½-3600	1½-3600	2-3600	1½-3600
60....Hp.-R.p.m.	½-1800	½-1800	½-3600	¾-3600	1-3600	1-3600	1-3600	1½-3600	1½-3600	1½-3600	1½-3600	2-3600	2-3600	2-3600
75....Hp.-R.p.m.	½-1800	½-1800	¾-1800	¾-3600	1-3600	1½-3600	1½-3600	1½-3600	2-3600	2-3600	2-3600	2-3600	3-3600	3-3600
100....Hp.-R.p.m.	½-1800	¾-1800	1-3600	1-3600	1-3600	1½-3600	1½-3600	2-3600	2-3600	2-3600	3-3600	3-3600	3-3600	3-3600
125....Hp.-R.p.m.	½-1800	1-1800	1-3600	1½-3600	1½-3600	2-3600	2-3600	2-3600	3-3600	3-3600	3-3600	3-3600	5-3600	5-3600
150....Hp.-R.p.m.	1-1800	1-1800	1-3600	1½-3600	2-3600	2-3600	2-3600	3-3600	3-3600	3-3600	5-3600	5-3600	5-3600	5-3600
175....Hp.-R.p.m.	1-1800	1-1800	1½-3600	1½-3600	2-3600	2-3600	3-3600	3-3600	3-3600	5-3600	5-3600	5-3600	5-3600	5-3600
200....Hp.-R.p.m.	1-1800	1-1800	1½-3600	1½-3600	2-3600	2-3600	3-3600	3-3600	5-3600	5-3600	5-3600	5-3600	5-3600	7½-3600

*Type DN Monoblock. Courtesy, Worthington Pump & Machy, Corp., 1952,

A Guide to Life Expectancy and Depreciation Rates of Ceramic Equipment

	Years	%		Years	%
Agitators	8	12½	Lehrs	15	6¾
Auger machines	14	7	Loading machines	5	20
Autoclaves	10	10			
Automatic stoverooms	10	10			
Baggers	15	6¾	Machine shop equipment	20	5
Bin vibrators	10	10	Mangles	10	10
Blacksmith shop equipment	15	6¾	Mills, ball	10	10
Block machines	8	12½	Mixers	7	14
Blowers	10	10	Molds, dry press brick	5	20
Blungers	10	10	Molds, glass	2	50
Brick machines, soft mud	14	7	Molds, hydraulic	12	8½
Brick machines, stiff mud	14	7	Molds, plaster	1	100
Bundling machines	18	5½	Mud machines, soft	14	7
Burners	8	12½			
Burning tools, enamel	5	20	Ovens, flattening	12½	8
Cars:			Packers	10	10
Batch	5	20	Pallets and trays	8	12½
Dryer or kiln	15	6¾	Pans, dry	10	10
Steel	10	10	Plungers	10	10
Wood	5	20	Polishers	12½	8
Transfer	10	10	Presses, dry	10	10
Carts	5	20	Presses, tile and sagger	10	10
Casting and rolling tables	12½	8	Pug mills	14	7
Charging machines, tank	10	10	Pullers, car	20	5
Controllers, temperature, automatic	10	10	Pulverizers	8	12½
Conveyors	10	10	Pumps, water	8	12½
Coolers	10	10	Pumps, clay slip	8	12½
Cranes, traveling	20	5			
Cut-off machines	8	12½	Riddles, gyratory	10	10
Cutters, brick and tile	10	10	Rim discharge grinder	15	6¾
Cutters, lens	7	14	Rolls, conical	15	6¾
			Rolls, crusher, double	15	6¾
Disintegrators	8	12½	Rolls, smooth	15	6¾
Draglines:			Sand-blast equipment	10	10
Heavy	20	5	Scales:		
Light	10	10	Platform	20	5
Medium	15	6¾	Portable	15	6¾
Drills:			Screens	8	12½
Lens	7	14	Screen heating equipment (electric)	15	6¾
Rock, tripod	5	20	Separators:		
Well	10	10	Air	10	10
Dryers	8	12½	Magnetic	6	16¾
Dryers, rotary	8	12½	Sewing machines	20	5
Dry pans	10	10	Shears, hand lever	10	10
Duster machines, bag	15	6¾	Shovels, electric or diesel	15	6¾
Dust collectors	20	5	Sieves	8	12½
			Sifters, revolving	8	12½
Elevators:			Spray booths	10	10
Bucket	15	6¾	Spray machine, automatic	10	10
Screw	8	12½	Sweeping systems	15	6¾
Engines, internal combustion	14	7			
Fans, exhaust	10	10	Tables, drawing, grinding, or polishing	12½	8
Feeders, clay	12½	8	Tanks:		
Filter presses	10	10	Mixing glaze	10	10
Furnaces, continuous enameling	15	6¾	Oil	30	3½
Furnaces, enameling, box	15	6¾	Pickling (brick lined)	15	6¾
Furnaces, glass	10	10	Pickling (lead lined)	5	20
Furnaces, pot	12½	8	Pickling (wood)	5	20
Glass forming machines	15	6¾	Slurry	16	6¾
Granulators	20	5	Storage—		
Grinders, abrasive wheel	20	5	Concrete	50	2
Guns, spray	2	50	Water (tower)	25	4
Hammers, air	15	6¾	Tile machines	17	6
Heaters, electric blower	10	10	Tipplers—		
Holsts, drum	14	7	Steel	25	4
Houses, batch	25	4	Wood	15	6¾
Hydrators	15	6¾	Tractors	6	16¾
Jiggers, automatic	10	10	Tramroads	20	5
Kilns, periodic, beehive	15	6¾	Tramways, aerial	15	6¾
Kilns, periodic, modern	5	20	Transformers	15	6¾
Kilns, tunnel	12½	8	Trippers, automatic	10	10
			Trucks, lift, battery driven	10	10
			Trucks, lift, gasoline	5	20
			Trucks, motor	10	10
			Turntables	15	6¾
			Tying machines, bag	20	5
			Vibratory feeders	10	10

Nomenclature of Welds



Vibrating Screen Capacities for Clay

Capacities obtained in tons per hour, in series of tests on average runs of damp clay after passing through dry pans, over one 3' by 8' well known make of vibrating screen, of the high speed, off-center-weight type, using medium light weights of square mesh wire cloth.

Damp, clay	tons per hour	Screen mesh	Size of wire	Size of openings	Per Cent of open area in this wire cloth	Per Cent of screening efficiency
	26.5	4	.054"	.187" (¾")	61.5%	94.0%
	21.7	6	.035"	.132" (½")	62.7%	95.7%
	19.3	8	.025"	.097" (⅜")	60.2%	93.5%
	16.2	10	.025"	.077" (⅜")	59.3%	93.3%
	11.8	12	.020"	.063" (¼")	57.2%	92.8%
	8.4	16	.017"	.045" (⅜")	53.0%	92.1%
	6.9	20	.013"	.037" (⅜")	54.8%	92.4%

Under favorable conditions, larger capacities are often obtained. Much depends upon the nature of the material, shape of particle, moisture content, percentage of plus or minus and evenness of the feed.

Checked by Universal Vibrating Screen Co., 1952

Four-figure table for converting:

1. Volume of drying shrinkage (percentage of dry volume) to linear drying shrinkage (percentage of dry length).
2. Volume of firing shrinkage (percentage of fired volume) to linear firing shrinkage (percentage of fired length).
3. Volume of expansion (percentage of initial volume) to linear expansion (percentage of initial length).

Percentage volume change	Percentage volume change										Differ- ences
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
	Percentage linear change										
0	0.000	0.033	0.067	0.100	0.133	0.166	0.200	0.233	0.266	0.299	0.033
1	0.332	0.365	0.398	0.431	0.464	0.497	0.530	0.563	0.596	0.629	0.033
2	0.662	0.695	0.728	0.761	0.794	0.826	0.859	0.892	0.925	0.957	0.033
3	0.990	1.023	1.055	1.088	1.121	1.153	1.186	1.218	1.251	1.283	0.033
4	1.316	1.348	1.381	1.413	1.446	1.478	1.510	1.543	1.575	1.607	0.032
5	1.640	1.672	1.704	1.736	1.769	1.801	1.833	1.865	1.897	1.929	0.032
6	1.961	1.993	2.025	2.057	2.089	2.121	2.153	2.185	2.217	2.249	0.032
7	2.281	2.313	2.345	2.376	2.408	2.440	2.472	2.503	2.535	2.567	0.032
8	2.599	2.630	2.662	2.693	2.725	2.757	2.788	2.820	2.851	2.883	0.032
9	2.914	2.946	2.977	3.009	3.040	3.071	3.103	3.134	3.165	3.196	0.031
10	3.228	3.259	3.291	3.322	3.353	3.384	3.415	3.446	3.478	3.509	0.031
11	3.540	3.571	3.602	3.633	3.664	3.695	3.726	3.757	3.788	3.819	0.031
12	3.850	3.881	3.912	3.943	3.973	4.004	4.035	4.066	4.097	4.127	0.031
13	4.158	4.189	4.219	4.250	4.281	4.311	4.342	4.373	4.403	4.434	0.031
14	4.464	4.495	4.525	4.556	4.586	4.617	4.647	4.678	4.708	4.739	0.030
15	4.769	4.799	4.830	4.860	4.890	4.921	4.951	4.981	5.011	5.042	0.030
16	5.072	5.102	5.132	5.162	5.192	5.222	5.253	5.283	5.313	5.343	0.030
17	5.373	5.403	5.433	5.463	5.493	5.523	5.553	5.583	5.612	5.642	0.030
18	5.672	5.702	5.732	5.762	5.791	5.821	5.851	5.881	5.910	5.940	0.030
19	5.970	6.000	6.029	6.059	6.088	6.118	6.148	6.177	6.206	6.236	0.030
20	6.266	6.295	6.325	6.354	6.384	6.413	6.443	6.472	6.501	6.531	0.029
21	6.560	6.590	6.619	6.648	6.678	6.707	6.736	6.765	6.795	6.824	0.029
22	6.853	6.882	6.911	6.940	6.970	6.999	7.028	7.057	7.086	7.115	0.029
23	7.144	7.173	7.202	7.231	7.260	7.289	7.318	7.347	7.376	7.405	0.029
24	7.434	7.463	7.491	7.520	7.549	7.578	7.607	7.635	7.664	7.693	0.029
25	7.722	7.750	7.779	7.808	7.836	7.865	7.894	7.922	7.951	7.980	0.029
26	8.008	8.037	8.065	8.094	8.122	8.151	8.179	8.208	8.236	8.265	0.028
27	8.293	8.322	8.350	8.378	8.407	8.435	8.463	8.492	8.520	8.548	0.028
28	8.577	8.605	8.633	8.661	8.690	8.718	8.746	8.774	8.802	8.831	0.028
29	8.859	8.887	8.915	8.943	8.971	8.999	9.027	9.055	9.083	9.111	0.028
30	9.139	9.167	9.195	9.223	9.251	9.279	9.307	9.335	9.363	9.391	0.028
31	9.418	9.446	9.474	9.502	9.530	9.557	9.585	9.613	9.641	9.668	0.028
32	9.696	9.724	9.751	9.779	9.807	9.834	9.862	9.890	9.917	9.945	0.027
33	9.972	10.00	10.02	10.05	10.08	10.11	10.14	10.16	10.19	10.22	0.030
34	10.25	10.27	10.30	10.33	10.36	10.38	10.41	10.44	10.47	10.49	0.030
35	10.52	10.55	10.58	10.60	10.63	10.66	10.68	10.71	10.74	10.77	0.030
36	10.79	10.82	10.85	10.87	10.90	10.93	10.96	10.98	11.00	11.03	0.030
37	11.06	11.09	11.12	11.14	11.17	11.20	11.23	11.25	11.28	11.31	0.030
38	11.33	11.36	11.39	11.41	11.44	11.47	11.49	11.52	11.55	11.57	0.030
39	11.60	11.63	11.65	11.68	11.71	11.74	11.76	11.79	11.82	11.84	0.030
40	11.87	11.90	11.92	11.95	11.98	12.00	12.03	12.05	12.08	12.11	0.030
41	12.13	12.16	12.19	12.21	12.24	12.27	12.29	12.32	12.35	12.37	0.030
42	12.40	12.43	12.45	12.48	12.50	12.53	12.56	12.58	12.61	12.64	0.030
43	12.66	12.69	12.71	12.74	12.77	12.79	12.82	12.85	12.87	12.90	0.030
44	12.92	12.95	12.98	13.00	13.03	13.05	13.08	13.11	13.13	13.16	0.030
45	13.19	13.21	13.24	13.26	13.29	13.31	13.34	13.37	13.39	13.42	0.030
46	13.44	13.47	13.50	13.52	13.55	13.57	13.60	13.62	13.65	13.68	0.030
47	13.70	13.73	13.75	13.78	13.81	13.83	13.86	13.88	13.91	13.93	0.030
48	13.96	13.99	14.01	14.04	14.06	14.09	14.11	14.14	14.17	14.19	0.030
49	14.22	14.24	14.27	14.29	14.32	14.34	14.37	14.39	14.42	14.44	0.030
50	14.47	14.50	14.52	14.55	14.57	14.60	14.62	14.65	14.67	14.70	0.030

(Courtesy of Dr. A. E. R. Westman, American Ceramic Society)

Temperature Conversion Tables

0 to 100			100 to 1000			1000 to 2000			2000 to 3000		
C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.
-17.8	32.0	10.0	50	122.0	38	100	212	260	500	932	1500
-17.2	33.8	10.6	51	123.8	43	110	230	266	510	950	1510
-16.7	35.6	11.1	52	125.6	49	120	248	271	520	968	1520
-16.1	37.4	11.7	53	127.4	54	130	266	277	530	986	1530
-15.6	39.2	12.2	54	129.2	60	140	284	282	540	1004	1540
-15.0	41.0	12.8	55	131.0	66	150	302	288	550	1022	1550
-14.4	42.8	13.3	56	132.8	71	160	320	293	560	1040	1560
-13.9	44.6	13.9	57	134.6	77	170	338	299	570	1058	1570
-13.3	46.4	14.4	58	136.4	82	180	356	304	580	1076	1580
-12.8	48.2	15.0	59	138.2	88	190	374	310	590	1094	1590
-12.2	50.0	15.6	60	140.0	93	200	392	316	600	1112	1600
-11.7	51.8	16.1	61	141.8	99	210	410	321	610	1130	1610
-11.1	53.6	16.7	62	143.6	100	212	413	327	620	1148	1620
-10.6	55.4	17.2	63	145.4	104	220	428	332	630	1166	1630
-10.0	57.2	17.8	64	147.2	110	230	446	338	640	1184	1640
-9.44	59.0	18.3	65	149.0	116	240	464	343	650	1202	1650
-8.89	60.8	18.9	66	150.8	121	250	482	349	660	1220	1660
-8.33	62.6	19.4	67	152.6	127	260	500	354	670	1238	1670
-7.78	64.4	20.0	68	154.4	132	270	518	360	680	1256	1680
-7.22	66.2	20.6	69	156.2	138	280	536	366	690	1274	1690
-6.67	68.0	21.1	70	158.0	143	290	554	371	700	1292	1700
-6.11	69.8	21.7	71	159.8	149	300	572	377	710	1310	1710
-5.56	71.6	22.2	72	161.6	154	310	590	382	720	1328	1720
-5.00	73.4	22.8	73	163.4	160	320	608	388	730	1346	1730
-4.44	75.2	23.3	74	165.2	166	330	626	393	740	1364	1740
-3.89	77.0	23.9	75	167.0	171	340	644	399	750	1382	1750
-3.33	78.8	24.4	76	168.8	177	350	662	404	760	1400	1760
-2.78	80.6	25.0	77	170.6	182	360	680	410	770	1418	1770
-2.22	82.4	25.6	78	172.4	188	370	698	416	780	1436	1780
-1.67	84.2	26.1	79	174.2	193	380	716	421	790	1454	1790
-1.11	86.0	26.7	80	176.0	199	390	734	427	800	1472	1800
-0.56	87.8	27.2	81	177.8	204	400	752	432	810	1490	1810
0	89.6	27.8	82	179.6	210	410	770	438	820	1508	1820
0.56	91.4	28.3	83	181.4	216	420	788	443	830	1526	1830
1.11	93.2	28.9	84	183.2	221	430	806	449	840	1544	1840
1.67	95.0	29.4	85	185.0	227	440	824	454	850	1562	1850
2.22	96.8	30.0	86	186.8	232	450	842	460	860	1580	1860
2.78	98.6	30.6	87	188.6	238	460	860	466	870	1598	1870
3.33	100.4	31.1	88	190.4	243	470	878	471	880	1616	1880
3.89	102.2	31.7	89	192.2	249	480	896	477	890	1634	1890
4.44	104.0	32.2	90	194.0	254	490	914	482	900	1652	1900
5.00	105.8	32.8	91	195.8	488	910	1670	488	910	1670	1910
5.56	107.6	33.3	92	197.6	493	920	1688	493	920	1688	1920
6.11	109.4	33.9	93	199.4	499	930	1706	499	930	1706	1930
6.67	111.2	34.4	94	201.2	504	940	1724	504	940	1724	1940
7.22	113.0	35.0	95	203.0	510	950	1742	510	950	1742	1950
7.78	114.8	35.6	96	204.8	516	960	1760	516	960	1760	1960
8.33	116.6	36.1	97	206.6	521	970	1778	521	970	1778	1970
8.89	118.4	36.7	98	208.4	527	980	1796	527	980	1796	1980
9.44	120.2	37.2	99	210.2	532	990	1814	532	990	1814	1990
					538	1000	1832	538	1000	1832	2000

INTERPOLATION FACTORS

C.	0.56	1	1.8
	1.11	2	3.6
	1.67	3	5.4
	2.22	4	7.2
	2.78	5	9.0
	3.33	6	10.8
	3.89	7	12.6
	4.44	8	14.4
	5.00	9	16.2
	5.56	10	18.0

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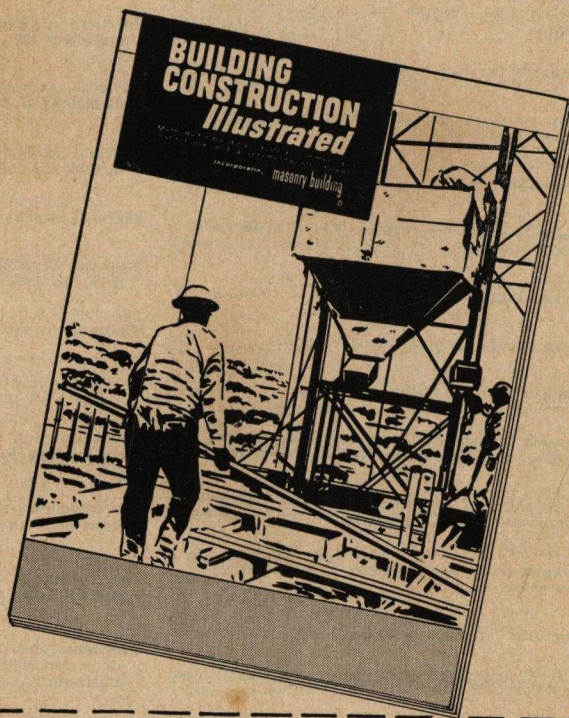
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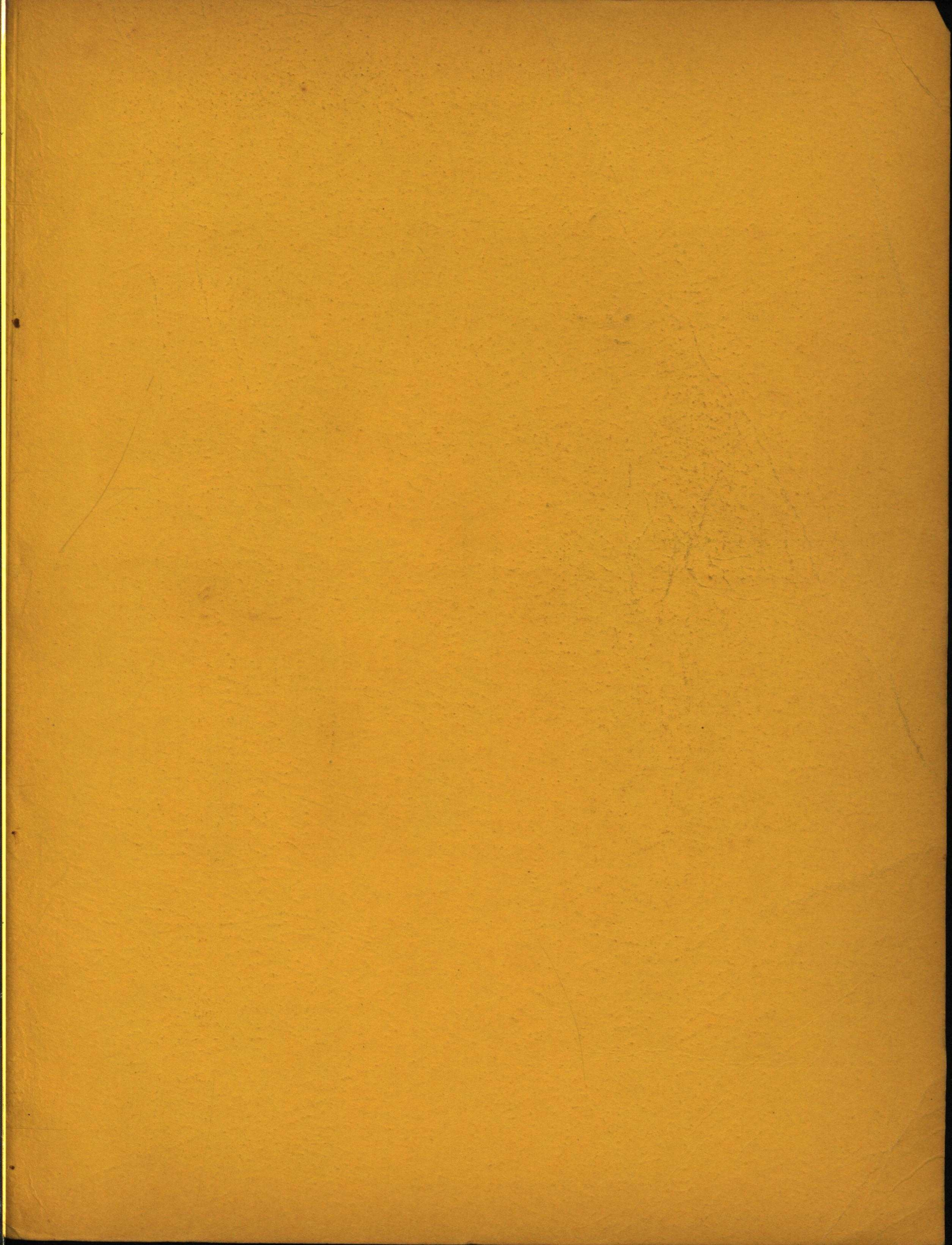
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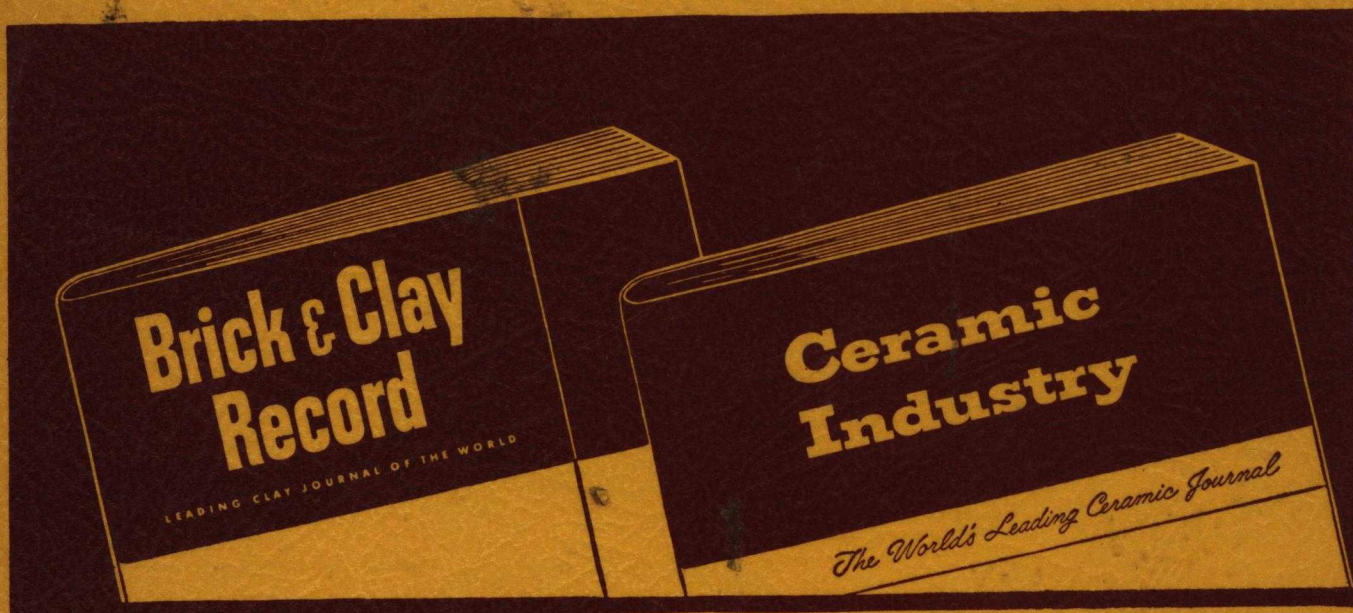
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drain tile
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and facing tile

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